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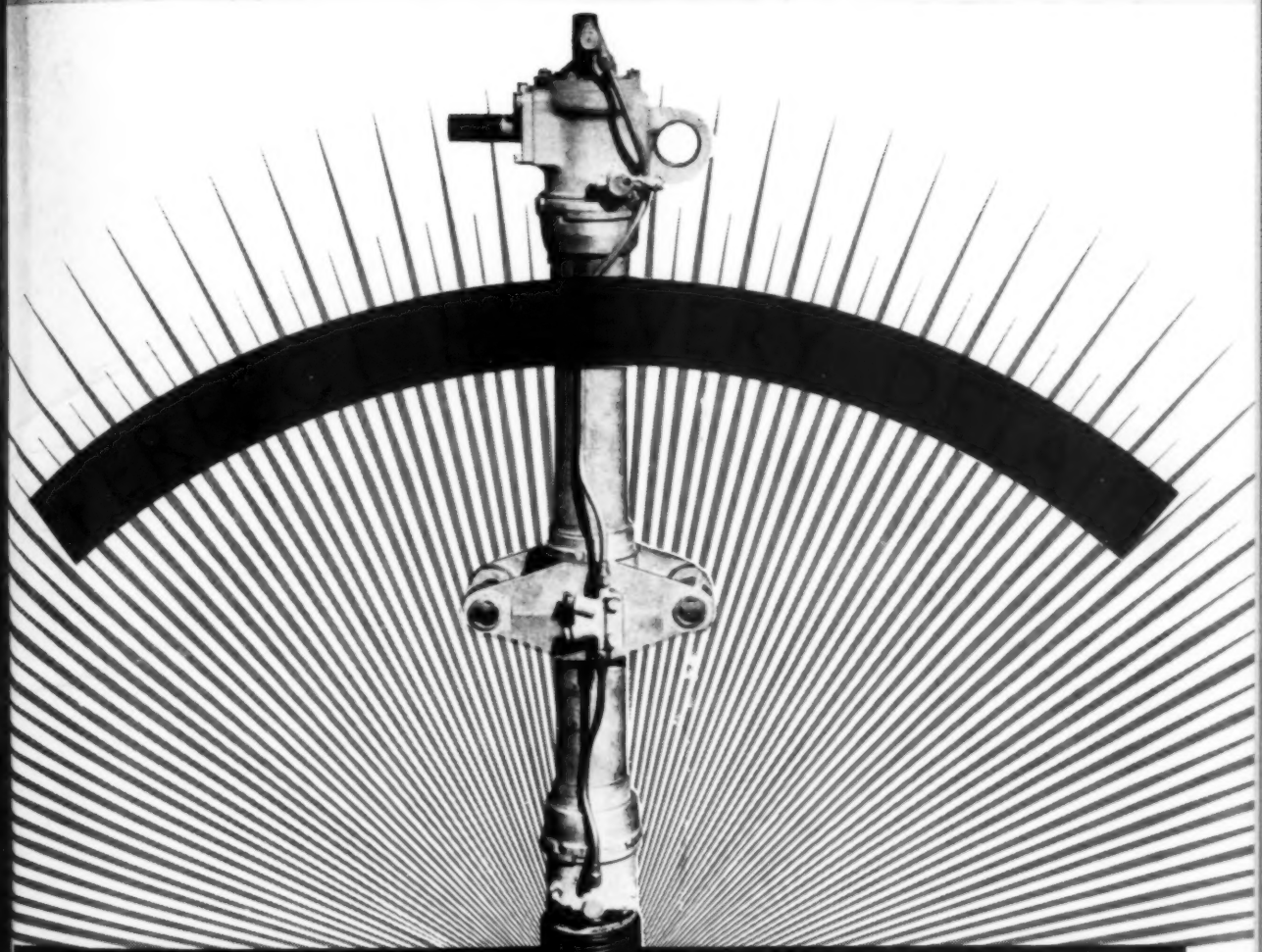

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and The AIRCRAFT ENGINEER

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The Outlook

A Great Air Day

THE need for training time has caused the War Office to abandon the popular Tidworth Tattoo and also to cut down the Bisley meeting from a fortnight to a week. The Royal Air Force is also very busily engaged in training, but none the less the Air Ministry decided to hold Empire Air Day. That took up a very great deal of time at a very great many stations; probably it consumed more time than was ever used up in preparation for the Hendon Display. Nevertheless, for this year at least, the time was doubtless very well spent.

Training for any form of popular flying display always gives practice to the units and the individuals concerned. The actual manœuvres practised may not always be of much use for war, but they certainly provide excellent advanced-flying training. There was probably another reason why the Air Ministry should this year let the public onto the R.A.F. stations to see things for itself at close quarters. The various international crises through which we have passed since last September, and all the subsequent A.R.P. energies, have made people extremely anxious about the air menace, and very keen to know that our air defences have been put into good shape. In September they were far short of what they should have been, and the public still needs a good deal of persuading that things are really very much better than they were. The sight of plenty of Hurricanes, Spitfires, and 3.7in. guns was a good way of inducing confidence.

We do not want the confidence which leads to lethargy, but we do want to banish anything in the nature of "jitters." In that way last Saturday must have had a very good effect.

Credit Where Credit is Due

THE general impression seems to be that the attendance at the various aerodromes was far larger this year than it has ever been before. Therefore, it follows that the good impression created has been greater than ever before. The Service charities will benefit accordingly, but the charity side is hardly the most important feature of Empire Air Day.

While it was naturally the R.A.F. aerodromes which aroused the greatest interest and attracted the greatest numbers of the public, one ought not to forget the good work done at the sixteen civil aerodromes which also were "at home" to the public. Likewise, while discussing the part played in the day by the Air Ministry, one ought not to forget that Empire Air Day is a conception of the Air League of the British Empire and its energetic Secretary-General, Air Comdre. Chamier. It might justly be described as the finest publicity device ever undertaken, though "publicity" is a word which has gained rather a commercial flavour of late. "Public relations" is the phrase more in fashion now, and this annual function has certainly brought the public into intimate relations with the flying movement.

For that reason it is well to emphasise the part played by the civil aerodromes. The times of crisis will pass, we all hope, but there will always remain the need for the British public to take an interest in the air. We may, in fact, look forward optimistically to a time when the chief desire of the public will be to inspect the latest types of commercial aircraft, and when the throngs at the civil aerodromes will outnumber those at the R.A.F. stations. Then, perhaps, the good work done by the Air League will be more fully realised than it has yet been in these days of wars and rumours of wars.

Festina Lente

NO one admires the goood work done by Pan-American Airways more than does *Flight*, and the inauguration of the first *regular* air mail service across the Atlantic is an historical event, to the credit for which the great American company is fully entitled. We are not ready yet, for reasons which were explained in last week's issue, and we shall not be ready for some weeks. In the circumstances we have no one to blame if America steals a march on us and gets going while we are fiddling. In any event, our cousins had a very excellent reason for making the first regular trans-atlantic mail flight to Marseilles just when they did. It was on May 20-21, 1927, that Charles Lindbergh made his now-famous solo flight from New York to Paris, and it was but natural that Americans should wish to commemorate that event by inaugurating the Atlantic mail.

Nor have we anything but admiration for the way in which Pan-American Airways carried out the flight. What we *are* concerned about is the prospect of the company starting a regular passenger service as soon as the five mail flights stipulated by the Civil Aeronautics Authority have been carried out. That seems to us far too short an experimental period to provide the experience needed before the carrying of passengers can be undertaken with the requisite degree of confidence.

We need hardly stress the harm that would be done to the whole project of transatlantic flying by one serious mishap resulting in the loss of many fare-paying passengers. It is one thing to make long flights over the Atlantic on picked days of the summer. It is quite another to operate the route to a fixed time-table, irrespective of weather conditions. And we hope that Imperial Airways will not let themselves be stampeded into inaugurating a passenger service until a great deal more experience has been accumulated.

Homage to a Pioneer

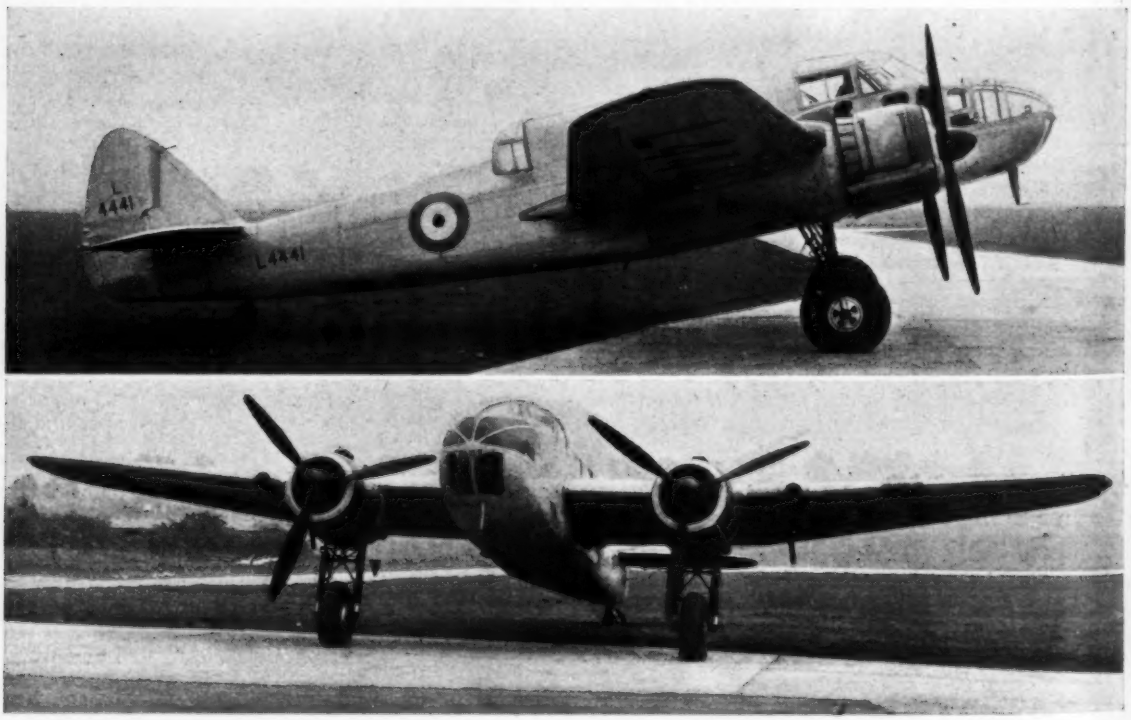
ONCE more it becomes the privilege of British aviation to pay homage to the father of flying. This year's Wilbur Wright Memorial Lecture is being given this evening by Dr. George W. Lewis, Director of Aeronautical Research of the American National Advisory Committee for Aeronautics. Dr. Lewis, appropriately enough, deals with modern methods of research, and his lecture begins with an account and some pictures illustrating the research work done by the Wright brothers.

It seems a somewhat curious fact that not until now has the story of how Wilbur and Orville probed fundamental problems been told. It has been known that they did a great deal of research, and it has been known that they used a wind tunnel, but we do not recollect ever seeing photographs or drawings of the tunnel.

One cannot help marvelling at learning, for instance, that Wilbur and Orville fully appreciated "scale effect" as early as 1901, and that they evolved a method of automatically correcting test results obtained at low Reynolds Numbers to make them applicable to full scale. That alone shows how deeply the brothers went into the subject before they ever ventured into the air.

The equipment at their disposal was of necessity crude and elementary, but the Wright brothers knew what they were after and did marvels within the limitations of their outfit. By comparison the modern research laboratories are wonders of precision, and it is with these mainly that Dr. Lewis deals.

When Dr. Joseph Ames gave his Wilbur Wright Memorial Lecture in 1923 *Flight* took it upon itself to apologise to him in a leader for the very poor attendance at the R.Ae.S. This evening we expect to find a full house. Research has changed in the meantime, but the R.Ae.S. has changed even more!



THE BEAUFORT: Slightly suggestive, in frontal aspect, of the Blenheim, but actually very different, the Bristol Beaufort is revealed as a reconnaissance torpedo bomber equipped with Bristol Taurus sleeve-valve engines of over 1,000 h.p. each. A note on this new machine appears on p. 530.

EMPIRE AIR DAY

Record Crowds at 62 Service and 16 Civil Aerodromes

Over a crowd reminiscent of R.A.F. Display days—A.A.F. Blenheims taking-off at Hendon.

EMPIRE Air Day, gaining added lustre because this is the majority year of the Royal Air Force and because the public consciousness is now wide awake to the importance of the Third Service, was such a success that it almost defeated its own object.

From almost every one of the 62 Service stations and 16 civil aerodromes open to the public came tales of record crowds. At some of the London centres, if nowhere else, the car invasion was so heavy that traffic-bound visitors gave up hope of reaching their goal and fought their ways home again.

Here and there, it seems, organisation of the displays slipped up, partly owing to the unprecedented influx of visitors and partly to the high-pressure training and expansion which the Royal Air Force is undergoing. In the circumstances, to anyone with any knowledge of the amplitude of the expansion, it is little short of miraculous that the Service should be able to stage this vast show at all; nor must we omit to give credit to the hard work of what theatreland calls the "house manager"—in this case the Air League of the British Empire.

Sir Kingsley Wood, Secretary of State of Air, accompanied by Capt. Balfour (Under-Secretary) and Air Chief Marshal Sir Cyril Newall, Chief of the Air Staff, made an extensive air tour of the stations during the Day.

Formations of Blenheims, Spitfires, Hurricanes, Battles and other aircraft visited a large number of stations in turn, and the organisation of their flying schedules must have been a Herculean task in itself.

Sqn. Ldr. G. H. Stainforth, of Schneider Trophy fame, flew in a Spitfire from Netheravon, Wilts, to Evanton, Ross-shire, and back. Though he made six calls at aerodromes *en route*, he completed the 1,070-mile journey in 3 hr. 5 min. flying time.

This year, happily, there was an almost entire absence of accidents. There was one nasty crash involving a Lysander at Ringway, Manchester, but nothing more serious than mild boundary-demolishing anywhere else.

Probably the worst casualties were suffered by the secrecy regulations in which the R.A.F. is now shrouding itself. The whereabouts and equipment of squadrons is now supposed to be more or less an official mystery, but time and again on Saturday both programmes and loud speaker announcements let the squadron cat out of the station bag.

In the following pages are a cross-section of the Day; some reports from typical stations picked at random:—

HENDON

LIKE gladiators returning to a crumbling ancestral arena three Hurricanes swept over waiting Hendon. "Scrounging" flying kit in the crew room was a distraction, but we were able to appreciate the Hurricanes' first-rate high-speed formation work and persistent, spirited "shootings up."

While taxi-ing out in a Blenheim of an Auxiliary fighter squadron we admired the effortless slow rolls of a camouflaged Gauntlet. But when our Squadron-Leader pilot pushed open the throttles of the twin Mercuries and we were pressed into our seat by that almost arrow-like acceleration, our interest centred on our own contribution to the programme: we were off (there were three in the formation) to engage six raiding Blenheims.

Clumps of faces followed our swift, low passage over the enclosures as the Blenheims drew their wheels into the bulbous nacelles and nosed up into the gathering grey murk. The Squadron Leader spoke intermittently into his microphone mask as we searched for our quarry, but we could hear or see little until he ordered "prepare for attack" and we glimpsed a green and brown half-dozen Blenheims some hundreds of feet below. The wheel went over and the control column forward and we were staring through our nose transparency at our swift drab targets set out in plan below. The A.S.I. needle was soon up in the 280 neighbourhood, though the Mercuries were operating at comparatively low boost.

Actually we reached about 300 m.p.h. before swinging out, up and away from the raiders in what seemed like a variety of Immelman turn, the "G" dragging at our temples.

Back on the straight and level our consorts, which had followed us into the fray, were soon rejoined in formation, but we had lost the raiders. The Squadron Leader became intent on the landscape and managed to spot them in the afternoon greyness. We dipped again, this time a shallower, longer approach but equally accurate. Tipping our wings derisively past the vertical, we rejoined formation and motored in for the landing.

[Another member of *Flight's* staff flew in one of the raiding Blenheims. His impressions follow.—ED.]

Flying in Vic formation at about 2,500ft., we cruised around gently, circling Hemel Hempstead, St. Albans, Radlett and Redbourne. We then prepared to bomb Hendon Aerodrome.

From the rear turret one searched the sky for the defensive interceptors, which were almost certainly lurking above. Approaching Hendon from a south-westerly direction, and when our position was just over Radlett, three defending Blenheims in Vic formation came into view a few miles behind. They caught up with us slowly, flying about 1,500ft. above. By the time we reached Mill Hill they were almost overhead and presently changed to echelon and prepared to attack.

In quick succession they peeled off, diving almost vertically at our tails at terrific speed. In turn they dropped down until momentarily obscured by the tailplane, only to pull out and shoot up behind us at less than 50 yards range, finally rolling practically over on their backs high above. For a second or two their undersides made a perfect target for our rear gun. The fighters formed up again as we turned on the London side of the aerodrome to fly back again over our objective.

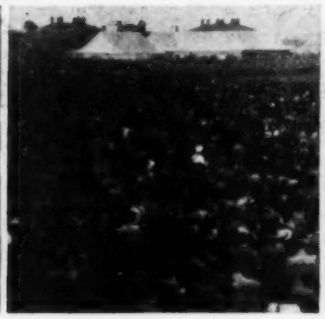
A second attack was made right over the aerodrome, and this time the fighters all pulled out on our port side, zooming up again practically together and again exposing themselves to our rear guns at quite close range. As they pulled out we saw our No. 4, the outside man on the starboard side, drop out of formation and slide away behind.

We had "lost" a machine and crew, but not before they had dropped their bombs on the objective.

MARTLESHAM

THIS year's display on Martlesham Heath, which marked the 21st anniversary of the Royal Air Force, was par-

Crowds—



Crowds—
Three Northolt glimpses.

—and more crowds.

ticularly impressive. This station is fortunate in having available so many of the latest types of aircraft, and among the many interesting items of the flying programme was the "Cavalcade of the Air, 1919-1939," a fly-past of 14 different types of aircraft. It was led by the Virginia, designed in 1919, and included the Fury and Henley, Wellington, Hudson and Spitfire.

Flight aerobatics by three Gladiators from Hornchurch was another popular item, and the fly-past of flying boats from Felixstowe cannot have failed to impress the spectators.

The difference of speed between the old and the new was well demonstrated in the exciting handicap race over a triangular course of about 40 miles. Although the scratch aircraft, a Spitfire, had not left the ground before the first, a Moth, had completed its first lap, a very close finish resulted, a Hudson being a narrow winner.

On the ground the public were given an opportunity to inspect the hangars, barrack rooms, dining-room and kitchen and the gymnasium, and amongst other exhibitions of particular interest were an hourly demonstration of a Hawker Hurricane firing its eight guns and an A.R.P. exhibit arranged by the Suffolk County Council.

The 18,000 people who attended the Display must certainly have been impressed by the very interesting and instructive programme.

DONCASTER

AT almost the last moment it was decided to hold the Empire Air Display at Doncaster again this year, instead of at Finningley as had been arranged. As has become a habit, the R.A.F. co-operated with the civil authorities to produce a good show, which opened with a demonstration of the refuelling, rearming and bombing-up of six Hampdens. This was followed with interest by the public, although it naturally lasted rather long for a non-flying event. His Worship the Mayor of Doncaster took the salute at a march-past of an A.A. detachment, the Civil Air Guard, and No. 103 Squadron, Air Defence Cadets, and then interest was turned skywards again by a display of individual aerobatics by an A.A.F. Gauntlet.

Possible "tension" after this event was relieved by the parachute descent of three dummies from a Whitley, and a comic contribution by the Sheffield Aero Club.

The arrival of the K.L.M. D.C.2 on the regular service aroused much interest, as did demonstrations of air drill and low-level practice bombing by Hurricanes and Hampdens respectively. The pupil-and-instructor turn by two Tutors was new to Doncaster and was well received. The Doncaster Aero Club formation in three Swallows with odd engines (two Pobjoys and a Cirrus) was quite impressive.

For the set-piece a local landmark was assumed to be a vital waterworks, and was attacked by Hampdens and defended by Hurricanes and A.A. guns.

Although the weather was a little doubtful, the attendance was over twenty-one thousand.

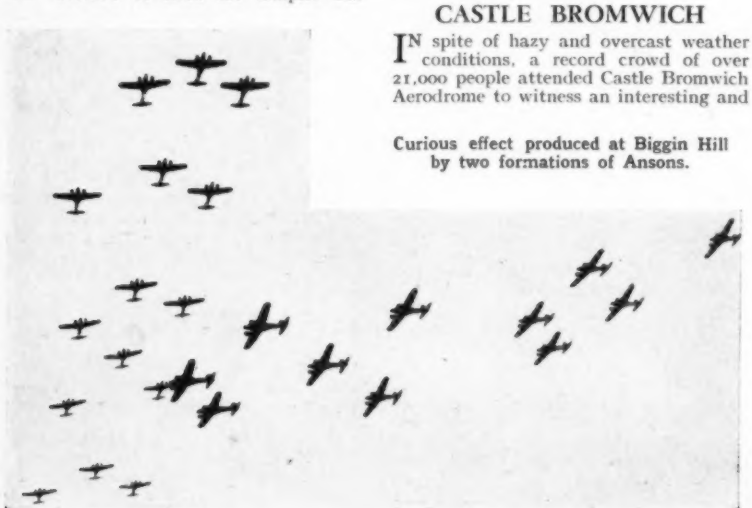
CASTLE BROMWICH

IN spite of hazy and overcast weather conditions, a record crowd of over 21,000 people attended Castle Bromwich Aerodrome to witness an interesting and varied flying display. The public enclosures were already crowded when nine Gladiator aircraft of the Auxiliary Air Force opened the programme with a flight in excellent formation around the outskirts of Birmingham. The second event was a fly-past of different types, including Hurricane, Blenheim, Harvard, Battle, Harrow and Oxford. This was followed by a very polished exhibition of individual aerobatics, formation drill by flights of Hurricanes and Spitfires, and low-level bombing attacks by Blenheims.

A very interesting and realistic finale to the display was the set-piece, in which two flights of bombers raided a munitions factory on the edge of the aerodrome. To the wail of the warning siren, the firing of anti-aircraft guns, and the bursting of bombs, the A.R.P., ambulance, demolition and anti-gas squads rushed to the rescue of the casualties.

During the latter part of the display the Secretary of State for Air, Sir Kingsley Wood, the Chief of the Air Staff, Sir Cyril Newall, and Air Vice Marshal Gossage landed and were entertained to tea.

An unexpected and appreciated item was a visit by an Ensign, which flew twice over the enclosures and gave the public of Birmingham their first view of this huge aircraft.



Curious effect produced at Biggin Hill by two formations of Ansons.

CRANFIELD (Bletchley)

WITH all the skill in the world, it becomes more and more difficult to make a Roman Holiday from the demonstration of modern high-speed military machines. In spite of the more than effective work by flights of Hurricanes and Blenheims, the general public at Cranfield seemed to be much more taken by the performances of the three veterans of varying ages brought over from Mr. Shuttleworth's workshops at Old Warden. In particular, the Sopwith Pup, which had previously been demonstrated at Duxford by Sqn. Ldr. Wheeler, provided a magnificent contrast between the war-time types and those which are used to-day, while Messrs. Edmunds and Shuttleworth did quite an exceptional amount of flying with the Deperdussin. The cross-Channel Bleriot made several short flights before its engine got so hot that it lost the 2 h.p. reserve necessary to get it into the air.

Probably the most attractive performance of the afternoon was by three Hurricane pilots, who went through their high-speed drill routine. When these same pilots demonstrated the method of attack—on three Blenheims—they had little chance of showing the machines off. The Hurricanes

merely formated about a quarter of a mile behind the Blenheims before breaking away. Nor, armed as they were with practice bombs and forced to aim by eye alone, did another trio of Blenheims manage to destroy the cardboard fort; it remained intact. There was a very good and representative selection of aeroplanes in the final fly-past, and the crowd obtained full value in sheer speed—particularly when a Hurricane, flying at 300-odd, *almost* met head-on an Airspeed Oxford travelling fast from its dive in the opposite direction. They missed by feet only.

ALDERGROVE

EMPIRE Air Day, 1939, was held at Aldergrove in cool but dry weather. The Met. Section having arranged for grey skies, the public, who turned up in their thousands, enjoyed the privilege of watching the evolutions of the aircraft without suffering from eye strain.

Lord Craigavon (the Premier of Northern Ireland) maintained his personal interest in aviation matters generally and in Aldergrove particularly, by attending, and afterwards expressing his gratification at the fine performance given.

From the four corners of Ulster spectators came by all modes of conveyance, from Shanks's mare to aeroplane. So it can be safely asserted that the crowd, which numbered 15,000 (an Aldergrove record), was thoroughly representative.

They saw "formating" by Ansons, Heyfords, Wallaces and Tutors; supplies dropped; balloons bombed most successfully from both high and low altitudes; a "dog-fight" of a very mild type; aerobatics at a very safe height; air drill which would have done credit to a guard of honour; a Blenheim and Spitfire showing their paces; and a grand finale consisting of the bombing of a fort. This last was a certainty from the start. It was a pity to take the money, for the encirclement (is one permitted to use the word?) was complete, and the "house of cards" collapsed.

A most entertaining item was the R/T. control of aircraft by members of the crowd. For a brief spell these spectators enjoyed the sensation of telling the pilot "what he should do with it."

In the interval a very interesting demonstration was given by members of the Ulster Model Aircraft Club.

CATTERICK

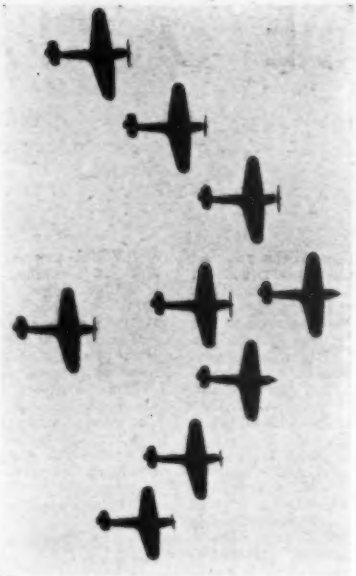
FINE weather attracted a crowd of about 12,000 people to Catterick aerodrome. The flying programme started at 2.15 p.m. and went smoothly through to the finish without being marred by any accidents. The high lights of the programme were:—

(1) Formation air drill by Spitfires. This item was well carried out and some excellent formation was shown to the public.

(2) Dive bombing on a target erected on the aerodrome, during which item a high degree of accuracy was obtained.

(3) A "shoot" by the Royal Artillery on a moving target. The crowd was given an excellent display of guns coming into action and engaging a target.

(4) An attack on a "native stronghold." This item provided many laughs. An aircraft was "brought down" by rifle fire from the tribesmen and the pilot captured and tied to a stake. The tribe was then attacked by Lysanders and the pilot rescued. Spitfires took up the attack and harassed the retreating enemy.



Hurricanes at Northolt

Great interest was shown in the "types park," where some of the latest aircraft were on view, including a Hampden and a Whitley. There were fifteen ground sections of the station open to view by the public.

HANWORTH

THE London Air Park is full of surprises to those unfamiliar with it, and its peculiar and attractive arrangement gave Saturday's multitude the chance to see far more than a flying display. A distant view of the aircraft park, in which the vast Bombay presided, as it were, over Harts, a Hurricane, Monospars and the Cygnet, led many visitors up the garden until they realised that they had to scuttle back through it to be in time for the first turn, which was taking place on the other side. Here it was made joyfully clear that a man in a Blackburn B.2 (from Flying Training, Ltd.) simply cannot hit a moving car with flour bags, turn he never so tightly.

While three Lysanders arrived from the north, two formations of Battles sailed superbly over. Followed a Fury with aerobatics of the high-speed variety, one screaming climb ending in a wiggle too unorthodox for even Mr. Michael Collins, commentating, to give a name to.

A high spot was the perfect synchronisation and placing of four parachutes released from three supply-dropping Lysanders. Then the Cygnet was dropped about by Mr. Hollis Williams, who lifted it off, turned it around and rammed it back again on the ground in the opposite direction on any wheel it seemed to fancy. People evidently liked that.

Some quite beautiful formation work on Harts by Volunteer Reservists, all trained at Hanworth in the last eighteen months, was succeeded by a smart inspection turn-out of 94 Squadron Air Defence Cadet Corps (Feltham), together with a Flight from 26 Squadron (Kingston), paraded by Sqn. Ldr. S. J. Noel Brown.

Synchronised aerobatics on Harts were good, and the Lysanders came back again with a smoke bombing display. We were then given a low down, high-speed flash-past in a Hurricane.

Mr. Brie's direct jumps-off in the C.40 Autogiro promoted, as ever, argument and wise prognostications.

THORNEY ISLAND

THOUSANDS of people crowded down the narrow country lane which leads off the main Portsmouth-Chichester road to Thorney Island, where one of Britain's latest Royal Air Force stations was open to the public for the first time since it came into being early last year.

Apart from the men's living quarters, the torpedo store was found by visitors to be worth more than mere passing interest, for they were able to see the intricacies of gyroscopic control and the remarkable power unit of the torpedo. One of the hangars was set out in true exhibition style, bedecked with signal flags. Here were displayed the Reconnaisance School's models of the world's fleets, and various types of machine guns and other equipment.

There was never a dull moment in the flying display. Vildebeests dive-bombed with reckless abandon on an antiquated Austin Seven, and in the middle of this act five Londons appeared in close formation and very nearly got dive-bombed into the bargain. Hurricanes then attacked five Ansons with almost uncomfortable realism. The pilot of "Anson H for Harry" gave over the radio a fascinating running commentary on flying, approaching and landing his Anson, to be followed by a demonstration of message picking up by a Vildebeest.

After an impressive fly-past—hats came off to the Blenheims and Hurricanes—the programme slickly finished with a bomb-cum-torpedo attack on a submarine set-piece—a grand show, even if the bombs did "strike" their objective before they had been released.

HALTON

HALTON, with its vast training school for Aircraft Apprentices, was obviously having a "parents' day," over and above the normal influx from Aylesbury and surrounding districts. Never have we seen quite so many faces shining with maternal and paternal pride.

Almost the whole of the magnificent workshops, barracks and other quarters were open for inspection, as were parts of Princess Mary's Royal Air Force Hospital, and one was impressed by the number of really modern aircraft (some of them admittedly a little battered by such peccadilloes as undercarriage-less landings) now provided for technical training. In and around the shops, for instance, were Spitfires, Hurricanes, Blenheims, Battles and Wellesleys.

There was a brass band and a drum-and-fife band (Halton has always been great on music); a barrage balloon; a massed P.T. display by 1,500 Apprentices; and a hornpipe demonstration by the Naval Air Apprentices under training there until such time as their own schools are ready.

Space, unfortunately, does not permit an account of the flying display, which included a capital humorous item involving a Tutor, an old lady, and a pilot who unwisely pulled his parachute ripcord while standing in the Tutor's slipstream. . . .

SERVICE AVIATION

Royal Air Force and Official Announcements :

Fleet Air Arm News : Military Aviation Abroad

The Bristol Beaufort

NOW that a limited amount of information has been released about the Beaufort general reconnaissance-torpedo bomber monoplane made by the Bristol Aeroplane Company, Ltd., it is possible to dispel the erroneous impression given by the Press of other countries that this aircraft is merely a development of the Blenheim. The machine is, in fact, of entirely new design and despite its improved accommodation and slightly larger dimensions as compared with the Blenheim probably ranks as the world's fastest bomber. It is stated by the Bristol company that the low structural weight of the Blenheim, which is only 30 per cent., has been surpassed in the Beaufort, and it is believed that the all-round performance is superior to that of the earlier type.

From the outset the Beaufort was designed for rapid production with a view to spreading the construction by a considerable subdivision of components. The machine is of fully stressed-skin construction and of mid-wing design. The tail wheel retracts with the main undercarriage and other features include hydraulically operated flaps and mass-balanced ailerons. A crew of four, consisting of pilot, navigator, gunner, and wireless operator, is normally accommodated. The engines are of the new Bristol Taurus small-diameter, two-row sleeve-valve type, developing over 1,000 h.p. each.

Overall dimensions of the Beaufort are: Span, 57ft. 10in.; length, 44ft. 2in.; and height, 14ft. 3in.

Apart from very large numbers of Beauforts ordered direct from the Bristol Company, it is understood that the machine will be put into production in Australia, the order being large enough to give direct employment to approximately 4,000 Australian workers and indirect employment to many more for the next two or three years. Australian-built Beauforts will be supplied to the Home and Commonwealth Governments, and are scheduled to meet requirements of the Royal Australian Air Force and of the Far East Command, Royal Air Force.

A Fighter by Martin Baker

MARTIN BAKER AIRCRAFT, LTD., have been test-flying an unorthodox low-wing monoplane single-seater fighter armed with multiple machine guns and fitted with a recent type of Napier Dagger 24-cylinder engine. Details of construction are still secret but the machine is understood to be as unusual internally as externally.

The Wellington's Performance

ACCORDING to figures issued by the Air Ministry, the Vickers Wellington bomber has a top speed of 257 m.p.h., a range of 3,240 miles, a service ceiling of 24,500ft., and climbs to 15,000ft. in 20.5 min. Span and length are 86ft. 1in. and 61ft. respectively. The engines are Bristol Pegasus XVIII's with two-speed superchargers.

Consolidated Flying Boat for R.A.F.

AN American Consolidated Model 28-5 twin-engined flying-boat has been ordered by the Air Ministry for experimental purposes and will be delivered to Felixstowe from San Diego during July. The flight will be made in two hops, the first from San Diego to Botwood (3,300 miles) and the second from Botwood to Felixstowe (2,450 miles). Similar machines are used as standard equipment in the U.S. Navy.

Airmen at the Tournament

A VERY popular item at the Royal Tournament, now in progress at Olympia, is the display by 96 young airmen from the Uxbridge Depot, to an accompaniment by the Royal Air Force band. The display includes orthodox p.t. exercises, figure marching at the double, and an extremely effective display with illuminated Indian clubs in a darkened arena. Seen even at the dress rehearsal, their precision seemed absolutely flawless, though—we were told—some of the men had had less than ten weeks' training.

There is also a display by No. 901 (Balloon) Squadron, using a small trainer type of balloon, while pupils from No. 3 School of Technical Training (Men), give a demonstration of parachute maintenance and packing.

Outside the arena is a R.A.F. stand, where a Spitfire—the actual machine, not a model—provides a striking contrast to an equally genuine S.E.5a, which we seemed to recognise as one of the inhabitants of Mr. R. G. J. Nash's stable of veterans at Brooklands.

Salonika Army and Black Sea Forces

THE eighteenth annual dinner of the Salonika Army and Black Sea Forces will take place on Friday, June 16, at the Café Royal, 68, Regent Street, London, W.1. Tickets are 14s. 6d. Field Marshal Lord Milne will preside, and officers of the R.F.C., R.N.A.S., or R.A.F. who served in those areas during the War, or in the Army of Occupation subsequently, are invited to attend. The attendance at this dinner usually approximates 300, and arrangements will be made, as heretofore, to get together a table representative of the above branches of the Service. It is particularly desired to increase the numbers of the flying personnel this year as of late these have dwindled, so all those eligible and interested are invited to apply, as soon as possible, or send their names to the Hon. Sec., Major E. V. Wellings, O.B.E., 123, Pall Mall, S.W., or to Flt. Lt. R. C. Preston, A.F.C., c/o R.A.F. Club, 128, Piccadilly, either of whom will be glad to give further particulars.

Flying Accidents

THE Air Ministry regrets to announce that F/O. (Act. Flt. Lt.) Gerald Elsmie (flying solo) lost his life in an accident which occurred in India, on May 17, to an aircraft of No. 39 Squadron.

A/C.2 Francis Roy Jones lost his life in an accident which occurred at Dartford, Kent, on May 18, to an aircraft of No. 25 Squadron Sgt. John Granville Lingard, the pilot, was not injured.

P/O. Nigel Avenel Van Someren lost his lift and A/C.1 Alfred Dennis Jacobs was dangerously injured in an accident which occurred near Penton Newsey, Hampshire, on May 19 to an aircraft of No. 59 Squadron.

Sub. Lt. (A) William Agard Sykes, R.N. (flying solo) lost his life in an accident which occurred in the Mediterranean on May 19, to an aircraft of H.M.S. *Glorious*.

F/O. John Fyrley Spanton lost his life, F/O. Froude Ridler Matthews and Midshipman (A) Colin Gerard Shaw Hodgkinson were dangerously injured and Midshipman (A) Arthur Taylor was slightly injured as the result of a collision in the air which occurred at Gravesend on May 12, between two aircraft of No. 20 Elementary and Reserve Flying Training School. F/O.s Spanton and Matthews were the pilots of their respective aircraft and Midshipmen Hodgkinson and Taylor formed the crews.

Owing to pressure on space, the Royal Air Force Gazette is unavoidably held over.

Forthcoming Events

MAY.

Sat., 27th. London-I.O.M. Race.
Mon. 29th. Manx Air Derby and Tynwald Race.

JUNE.

Sat., 17th. Brooklands Flying Club "At Home."
Official opening of Derby Municipal Airport (Burnaston) by Sir Kingsley Wood.
Wed., 21st. Aero Golfing Society: Jubilee Cup, Berkshire Golf Club.
Sat., 24th. Royal Air Force Garden Party.

JULY.

Sat., 1st. South Staffordshire Aero Club: Walsall Air Display.
Opening of Grangemouth (Scotland) Airport by Lord Trenchard.
Lancashire Aero Club: Garden Party at Woodford.
Sat., 8th. Official Opening of Birmingham Airport (Elmdon) by H.R.H. the Duchess of Kent.
Sat., 8th-Sun., 16th. National Gliding Contests, Great Hucklow.
Sat., 8th-Sun., 23rd. Brussels Aero Show.
Sat., 15th. Gosport Reunion, Brooklands.
Sat., 15th-Mon. 17th. Deauville Air Rally.
Sun., 16th-Sun., 23rd. Italian Aero Club: Littorio Rally, Rimini.
Sat., 22nd-Tues., 25th. Aero-Club de l'Ouest de la France: Plantagenet Rally.
Fri., 28th-Sun., 30th. Cannes Aero Club: Deauville-Vichy-Cannes Rally.
Sat., 29th-Sun., 30th. Frankfurt International Flying Meeting.

AUGUST.

Sat., 5th. Cinque Ports Flying Club: Folkestone Aero Trophy Race.
Sat., 12th. Eastbourne Flying Club. Flying Display and Garden Party.

SEPTEMBER.

Sat., 2nd. King's Cup Race and Wakefield Trophy Race. Birmingham.
Sun., 3rd. Gordon Bennett Balloon Race, Poland.
Sat., 16th. Cinque Ports Flying Club: Wakefield Cup Race.

BLIND-APPROACH SYSTEMS

Some Suggestions on Continuous Visual Information for the Pilot

By A. ROBERT EDIS.

AS a result of reading with interest the articles by Mr. Frank Brent in *Flight* of April 27 and May 4, entitled "Towards 100 per cent Regularity," I was impressed by his description of the blind approach and landing systems now in use.

One cannot but feel somewhat uneasy at the extreme concentration of attention and accuracy of control that are required of a pilot employing current methods.

It appears to me that all present systems have a fault in common, in that the crew of the aeroplane, in addition to flying their craft as in a normal landing, have to depend for knowledge of their immediate position on incoming radio signals of both visual and aural nature, some instantaneous in duration and others necessitating a radio enquiry or reply. The intermittent arrival of the information reaching the pilot and the rapidity with which his position relative to the aerodrome is changing make hurried, and therefore dangerous, decisions, calculations and adjustments of controls inevitable, thereby imposing a big mental strain on the crew.

It is clear, therefore, that an urgent need exists for some means of continuously informing the pilot of his exact whereabouts in the approach sector in such a manner that he may be able to *see* his position at any moment, without complicated references and calculations, and fly accordingly.

At the risk of rushing in where angels fear to tread, I outline below a scheme that has occurred to me, amounting to an improvement on a system described by Mr. Brent in his article as being in experimental use on the Continent.

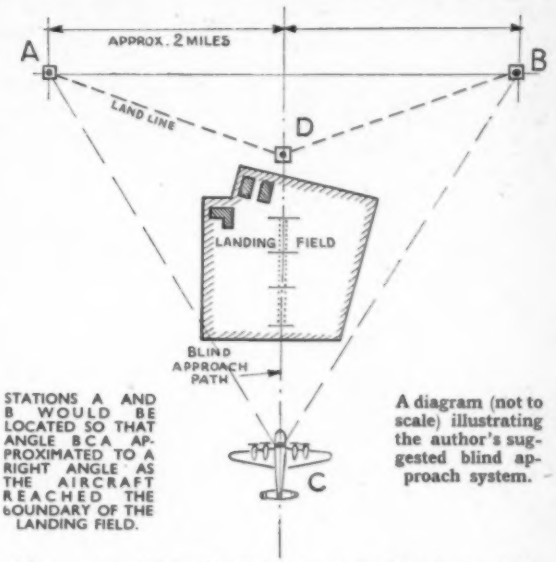
The Scheme

On the sketch herewith, A and B are directional radio receiving stations situated equidistant from the airport on a line at right angles to the approach line, and connected by land-line to a transmitting station D, which is situated in turn on the approach path produced.

The aircraft C makes its initial approach by homing on the radio station at D, enters the blind approach sector about 7 miles from the airport approximately along the approach path, and switches on its transmitter. Continuous signals indicating the bearing of the aircraft relative to the stations A and B at any instant are now radiated from D. These signals are received by the aircraft, where they are amplified and passed respectively to two milliammeters having long pointers. The spindles of the pointers would be located at A and B on a large-scale map of the approach sector mounted in the control cabin of the aircraft. This apparatus would be somewhat similar to that described on page 462 of *Flight* of May 4.

The intersection of the two pointers on the map would then indicate continuously and exactly to the pilot, simply by inspection, the position of his aircraft relative to the field.

Accurate information regarding the height of the aircraft would be provided by three sensitive altimeters (two do not give a check) connected in the usual way for barometric pressure at the airport.



STATIONS A AND B WOULD BE LOCATED SO THAT ANGLE BCA APPROXIMATED TO A RIGHT ANGLE AS THE AIRCRAFT REACHED THE BOUNDARY OF THE LANDING FIELD.

A diagram (not to scale) illustrating the author's suggested blind approach system.

My own knowledge of radio engineering is infinitesimal, but I believe that such a system is practicable to-day. The great advantage of the method would be to enable the pilot to fly his aircraft the whole time as if in normal visibility by providing *visual* evidence of his position in the sky during the whole approach. The time and speed of approach, wind speed and direction would be automatically corrected for by the pilot as he kept his aircraft moving along the approach line shown on the map before him, as indicated by the progress of the intersection of the pointers.

It will be seen that by standardisation of the position of the goniometer stations A and B relative to the transmitting station D and the landing field, at all airports, universal application of the system would be possible. The approach sector map appropriate to the airport at which the aircraft desired to land would be inserted in the indicator apparatus in the control cabin of the aeroplane.

An indicator map of about 15 inches square, with a scale of half a mile to the 1 inch, is suggested. With an aircraft ground speed of 100 m.p.h. there would be an equivalent change of position on the map of 1 inch every 18 seconds. As the airport itself would be approximately 1½ inches square on the map, this would appear to be a suitable scale, but such details are for the operators to decide.

In so hastily thought out and sketchy a scheme as I have given above, there will be many snags and technical difficulties that I have overlooked, and may I hope that others of your readers will suggest modifications and improvements?

Consolidated Private Venture

WHETHER or not the new Consolidated Model 31 flying boat has been designed in any way to the specification of American Export Airlines, the fact remains that it is an extremely interesting high-speed long-range type. The only indication given by the makers of its probable uses lies in the statement that the machine has a maximum capacity for fifty-two passengers and, for transatlantic work, accommodation for twenty-eight passengers.

The Model 31 is an all-metal cantilever high-wing boat with semi-retractable outboard floats—the wing-tips are too small in this model to permit full retraction—and hydraulic-operated Fowler flaps extending from the aileron to the hull. Following modern practice, there are two decks, the upper one carrying the crew and, presumably, a certain proportion of freight and mail.

The engines are two Wright eighteen-cylinder twin-row radials, which are rated at 2,000 h.p. each for take-off. These brand new—not to say secret-list engines—are being seen for the first time. In the circumstances it is unlikely that the boat will be available for some considerable period, though Export Airlines might obtain special permission to use it across the Atlantic. Three-bladed Hamilton Hydromatic full-feathering airscrews are used. The machine is not an amphibian, but it has built-in retractable beaching gear consisting of nose-wheel and two side wheels which swing upwards into the sides of the hull. The nose-wheel is a permanent installation, but the side wheels are removable in cases where maximum range with adequate payload is demanded.

No performance figures are yet available, but it is to be supposed that these will greatly exceed those of the well-known PBY in matters of speed, range and load capacity. The approximate all-up weight is 50,000 lb., and other figures are: Span, 110ft.; length, 73ft.; and maximum chord, 14ft. The 31 has been designed and built purely as a private venture by the Consolidated Aircraft Corporation.

Speechless

AN aviation party with no speeches and no "shop" (or very little) is an unusual event. Air-Cdr. Chamier's idea in planning the Air League of the British Empire "High Ball" at Grosvenor House on Monday of last week was to ensure freedom, and what is so painfully known as jollity. He succeeded—and some 650 people certainly made it seem that more space will be required next year. His Grace the Duke of Sutherland was in the chair, but rose only to call for the loyal toast and to explain that there would be no speeches.

ANOTHER A.R.B. YEAR

Good Progress Reported at Air Registration Board's Annual Meeting

LITTLE by little the Air Registration Board has been taking over the different duties which were delegated to it in July, 1934, by the Gorell Committee. Judging from the chairman's report at the annual general meeting on May 11, practically all these duties have now been taken over, and it might be said that the Board is now ready for machines larger than the stipulated maximum. More important still, airline pilots are now adequately represented on the Board, so that there should be fewer and fewer criticisms of a certain lack of sympathy on the part of manufacturers, and even of operators, for their particular difficulties.

At the meeting Sir Maurice Denny, the chairman, explained that new civil types and modifications thereto had now been taken over. The work actually started in July, and, although the transfer of the necessary functions from the Air Ministry was not yet quite complete, the Board was responsible for the majority of machines under 10,000 lb. all-up weight and carrying ten passengers or less. Certificate of Airworthiness renewals of civil types were now arranged through the A.R.B.

During the year 1,154 recommendations were made to the Secretary of State for the renewal or revalidation of certificates. Sir Maurice stressed the fact that it was impossible to forecast the number of renewals; on an average, between 1934 and 1938, there had been an increase of 95 per annum, but this had not been constant. The impetus given to civil flying by the subsidy additions would tend to accelerate the increase, and this possibility had to be kept in view in the development of the Board's organisation. There were even more considerable fluctuations during the course of each separate year.

Approved Construction

The Board had now approved 29 firms for the purpose of making records either directly to the Air Ministry or to the Board on the construction of "subsequent" aircraft—i.e., non-prototype machines—and under these arrangements recommendations had been made for the issue of 209 certificates. Seventeen firms had been approved for repair work to aircraft and engines. Of 2,000 firms which had been approved for the supply of materials for civil aircraft construction, only about 1,000 were likely to apply for ultimate approval, and it was necessary to investigate the work done by each. Up to March 31 eighty-nine approvals had been dealt with.

The Council hoped that similar freedom would be offered to design organisations, but present experience led them to believe that in this matter there was a tendency to place reliance on a controlling body. During the past year nineteen firms had been approved under the Air Navigation Directions for design as well as inspection work. It was not considered to be the proper function of the Board to encourage such reliance, but it was agreed that small firms should make use of available advice and assistance.

The Board, of course, was responsible for the examination and recommendation of ground engineers, and 440 new licences had been recommended and 1,016 licences varied or extended during the last year. The number of renewals was 1,276. There was a feeling amongst both engineers and operators that the system involved in the issue of G.E.'s licences was capable of improvement, and during the coming year an attempt would be made to formulate new proposals which would be discussed with those interested.

Since August last year the Board had been conducting the technical part of the examinations for the issue of extensions of pilot's "B" licences—as a temporary measure pending the introduction of a new procedure. For some time it had been the intention of the Air Ministry to introduce modifications to the procedure at present adopted for the extension of "B" licences to include additional machines. The Board had given the matter careful consideration, and a scheme had been prepared with the help of the G.A.P.A.N. and B.A.L.P.A. The present conditions are not stringent enough.

The expansion of the A.R.B.'s overseas organisation had been continued, and an office of the Board had recently been established in Nairobi, where the surveyor acts on behalf of the Governments of Kenya, Uganda, Tanganyika, and Zanzibar.

At the official luncheon which followed the general meeting and preceded further deliberations by the Board, the guest of honour was the Secretary of State for Air, Sir Kingsley Wood.

Sir Maurice Denny, in his customarily concise and humorous manner, briefly outlined the events of the year. He explained that it was the Board's second birthday and that, though no longer a child nursed by the Air Ministry, it nevertheless continued to be grateful to the Government. The work which had originally been delegated to it had now practically all been taken over, and only the technical control remained out of their hands. Very shortly the Board would approach the Air Ministry again about the possibility of being given the responsibility for larger civil aircraft types.

Although civil development had naturally been hampered to some extent by the necessary military expansion, the work involved was nearly twice that which was originally estimated, and it was impossible for the Board to keep within the limits of the financial arrangements originally made. These preliminary estimates were accurate enough, but, in view of the unexpected increase in civil aviation, were necessarily on the low side, and a re-examination of the financial position was essential.

In his reply Sir Kingsley Wood agreed that it was not unusual for a child to discover that his pocket money was inadequate. For the moment he could only say that the question of increased payments would be given the most careful consideration. He praised the work of the Board and regretted, in particular, the fact that Mr. Woods Humphery had necessarily had to resign pending his departure for Canada, but felt sure that his place would be usefully taken by Mr. Whitney Straight. He was encouraged by the figures which had been given in the report, and particularly so by the obvious signs of full co-operation between the constructors, operators, and other interests.

In spite of the rearmament demands, the Air Ministry was determined to do everything possible for civil aviation. At present there were 30,000 miles of British air routes, but he looked forward to a considerable increase and, at the same time, to the exclusive use of British machines on these routes. This country probably knew more about air transport operation than any other, and knew, at least, how to operate services with the maximum economy. Now that the subsidy arrangements were less restricted, the development should be more rapid.

The Whitsun Air Race

TWENTY-THREE competitors will take part in the Isle of Man Air Races this week-end. On Saturday, at about noon, the London-I.O.M. Race will start from Hatfield, and machines will fly non-stop to the Island, finishing at Ronaldsway. On Whit-Monday, May 29, Ronaldsway will be the starting and finishing points of the Manx Air Derby (over 120 h.p.) and the Tynwald Air Race (under 120 h.p.), round three laps of the Island. Entries appear below.

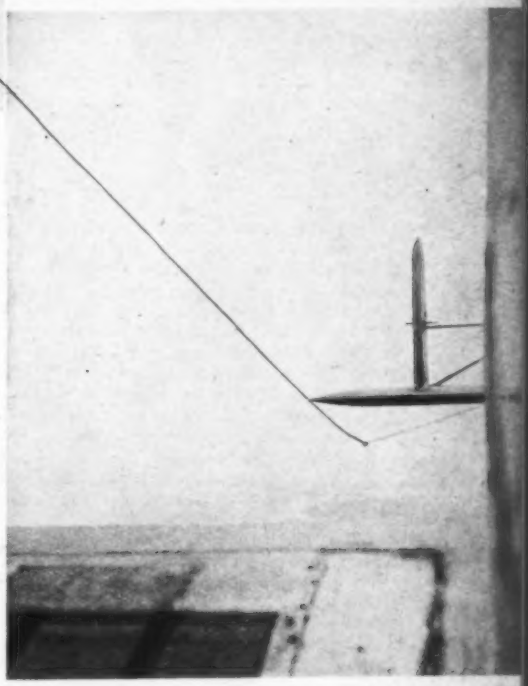
Racing No.	En'rant	Pilot	Type	Engine
*† 1	Viscount Wakefield	F/O G. R. de Havilland.	T.K.2	Gipsy Major
*‡ 2	H. O. Winter ...	R. A. Winter	Comper Swift ...	Gipsy III.
*† 3	Luis Fontes ...	Entrant (and T. Rose in Manx)	Miles Hawk Speed VI.	Gipsy VI.
* 4	Luis Fontes ...	F/Lt. T. Rose	B.A. Eagle ...	Gipsy Major.
*† 5	Alex Henshaw ...	Entrant ...	Mew Gull ...	Gipsy VI.
† 6	Albert Henshaw ...	Entrant ...	Vega Gull ...	Gipsy VI.
*‡ 7	S. Cummings ...	Entrant ...	Blackburn Bluebird.	Gipsy III.
*† 8	C. G. M. Alington...	Entrant ...	Miles Sparrowhawk.	Gipsy Major.
*† 9	J. M. Barwick ...	Entrant ...	Vega Gull ...	Gipsy VI.
*†10	Miss Mabel Glass ...	Entrant and Miss Sheila Glass.	B.A. Eagle ...	Gipsy Major.
*†11	T. W. Brook-Smith	Entrant ...	Miles Falcon ...	Gipsy VI.
*12	North Western Air Transport, Ltd.	G. E. Bowes-Stoney.	B.A. Double Eagle	Gipsy VI.
*‡13	F. Dawson Paul ...	Entrant ...	Chilton	Carden Ford.
*†14	The Marquess of Londonderry.	Entrant ...	D.H. Hornet ...	Gipsy Major.
*‡15	Janis Vitols ...	P. Avery ...	V.E.F. J.12 ...	Cirrus Minor.
‡16	Capt. Latimer-Needham.	Entrant ...	Luton Major ...	Mikron.
*17	E. A. Strouts ...	Entrant ...	Miles W. Straight	Gipsy Major.
‡18	A. R. Ward ...	R. A. Porteous	Chilton	Carden Ford.
†19	R. Blackburn ...	C. Napier ...	Gull	Cirrus Major.
*†20	— ...	Capt. E. W. Percival.	Mew Gull ...	Gipsy VI.
*‡21	Sqn. Ldr. H. R. A. Edwards.	Entrant ...	Avian	Hermes II.
‡22	E. D. Ward ...	Entrant ...	Tipsy Trainer ...	Mikron.
‡23	Sqn. Ldr. E. Mole ..	Entrant ...	Tipsy Trainer ...	Mikron.

* Entered for the London—Isle of Man Race

† Entered for the Manx Air Derby.

‡ " " Tynwald Race.

Sir Alan Cobham's System Explained : 1,000 Gallons in Less Than 15 Minutes



From Harrow to A.W. XXIII : The combination of two views gives a good idea of fuelling in the air. The nozzle of the hose pipe is nearing the cone in the tail of the A.W., drawn by the cable, which is shown slightly thickened to make it discernible. By no means the whole length of hose had been reeled off when the picture was taken.

FUELLING in the AIR

By C. M. POULSEN

(Illustrated with "Flight" photographs)

THAT some form of assisted take-off will be universally employed for long-range aircraft in the future may now be taken for granted.

To realise that this is so one has only to read the very able report written by Mr. Marcus Langley, in which he examines the effects of increased wing loading on range and pay-load. We hope to deal with that report on another occasion. For the present it will suffice if we quote from it one rather astonishing conclusion: the difference in range and pay-load between an aircraft taking off under its own power with its full load of fuel and one fuelled after it has got into the air is the difference between Ireland-Newfoundland with no pay-load and Southampton-New York with a pay-load of 7,000 lb. The effect on the £ s. d. of Atlantic operation is too obvious to require comment here.

Accepting Mr. Langley's figures (and he gives chapter and verse for them in an appendix to the report), the obvious conclusion is that assisted take-off is bound to come. The question still remains to be settled which particular form of assisted take-off? As we have stated on several occasions, *Flight* believes there is room for all the three main groups—catapult, composite and fuelling in the air (which is only indirectly assisted take-off). It all depends upon the particular use and the particular conditions which form is most suitable.

How It Has Developed

Flight has previously dealt at considerable length with both catapulting and with the Short-Mayo Composite. And now it has become the turn of fuelling in the air. We prefer to use that expression in preference to "refuelling" because—at present, anyway—it is intended to "top up" the tanks at the start of a flight, and not for replenishing them after a long flight has been completed. In so doing we may be slightly out of step with Sir Alan Cobham, who has called his company, "Flight Refuelling Ltd.," but that is a risk we must take.

Before describing the present system of fuelling in the air it may be of interest to recall briefly the steps by which Sir Alan Cobham has arrived at it. It all began with Sir Alan trying to analyse his feelings after many famous flights involving long "hops," such as England to South Africa, England to Australia, and so on. "What," he said to himself, "is it that has caused me the most anxiety?" On thinking it over he came to the conclusion that the answer was another question: "Have I got enough petrol to get there?" And the sleepless nights when worrying about the chances of getting off next morning with the big load of fuel on board for the next stage.

Then the Americans—in the pole-squatting era—started the seemingly senseless stunt of fuelling in the air in order to see how long an aeroplane could be kept aloft. In that Sir Alan was not interested, but he *was* interested in the possibility which the system offered of making very long non-stop flights with the aid of fuelling in the air. As early as 1931 he began toying with the idea, but for various reasons it was not until the next year that he was able to get down to ordered planning, and it was in 1933 that he began actual experiments. These were of necessity somewhat crude, relying on manual dexterity in catching the end of the hose and making it fast to the aircraft to be fuelled.

Sir Alan succeeded in getting the Air Ministry interested, and in 1934 he was planning on making a non-stop flight to India. He bought an Airspeed Courier and had it fitted up for air fuelling. A W.10 was sent to Malta to fuel him there, and various R.A.F. machines were to fuel him at Alexandria, Basra and Karachi. He and Sqn. Ldr. Helmore crossed France (without seeing it until Marseilles was reached) and arrived over Malta, where the Courier was successfully fuelled. Then, a few minutes after breaking away, it was discovered that the throttle control had broken! The engine died away gradually and just enabled them to reach Malta and make a landing with the wheels up *and all the petrol on board*. Sir Alan

frankly admits that he forgot all about the petrol. The flight had to be abandoned, but the experience had served to convince Sir Alan that he was on the right track.

Up till this time (viz., December, 1934) the theory had been that the "tanker" should fly steadily during the operation, while the aircraft to be fuelled should do all the "formating." By now Sir Alan began to change his mind about that. He reasoned that logically all the skill required, and all the special equipment, should be on board the tanker, so that all the pilot of the receiving aircraft would have to do would be to fly steadily and straight. And that has been the basis of all subsequent development.

Ever since 1934 Sir Alan Cobham has devoted all his unbounded energy, and a great deal of ready cash, to the development of fuelling. The company was reorganised a few years later, and the premises at Ford Aerodrome, Yapton, near Arundel, have had to be extended from time to time. The staff has also gradually grown, until now there is a very competent technical staff, drawing office and workshops. The latter are very well equipped so that the company is independent of outside help in most of its development work.

That this has been difficult is not surprising. First of all, it has been necessary to convert aircraft not initially designed with air fuelling in view. That takes some time. Then the necessary knowledge has had to be accumulated laboriously from actual test flights and experiments. So many of the factors which enter into the problem cannot be calculated in the drawing office but have to be discovered by trial and error methods (in the earlier stages perhaps "hit and miss" would have been a more apt description).

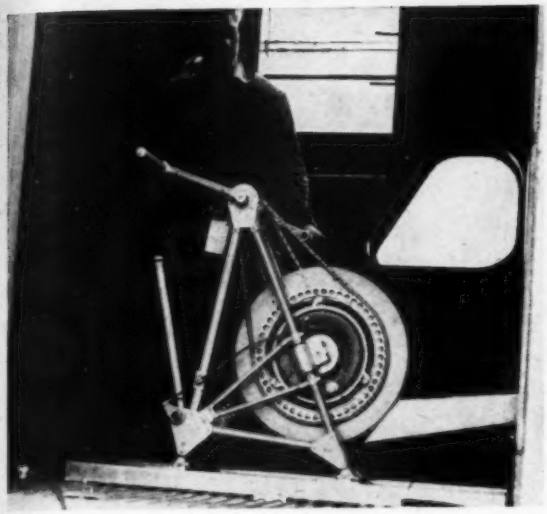
Fuelling Practical

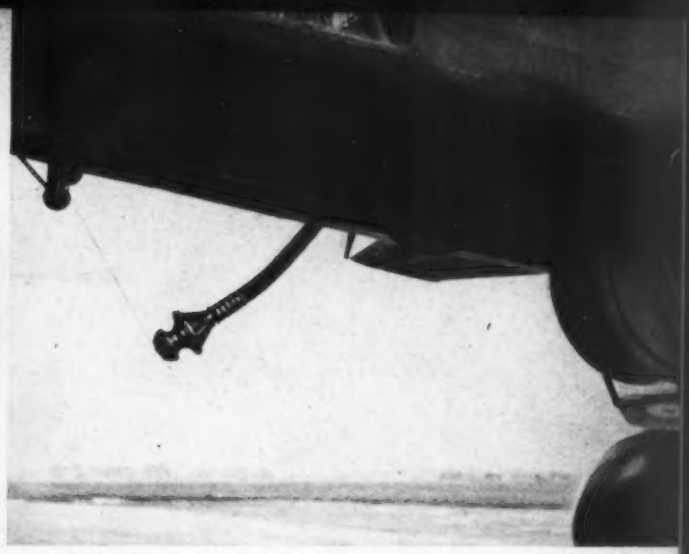
But Sir Alan's enthusiasm and organising ability have carried him through, and fuelling in the air has now reached, from the point of view of the tanker aircraft, a stage when it can justly be claimed to be a perfectly practical operation. That is not to say that it has reached the end of its development. Far from it; there are many directions in which the details can be improved; but the main scheme is there, ready and working.

The operation of fuelling one aircraft from another in flight may be divided into four stages: making contact; getting the hose-pipe across; transferring the fuel; and the breakaway when the tanks are full.

It is, of course, quite obvious that there are many possible ways in which a cable can be passed from one aircraft to the other. Most of them have been tried out at Ford. The one finally selected for fuelling the flying boats for this year's Atlantic experimental flights is known as the wing-tip method. Some of the others have been discarded and others are still in the experimental stage and not considered sufficiently proved to be used at the moment, although one or two show great promise and

Sequence of making contact: In the upper picture the tanker's grapnel has caught the hauling line of the receiving aircraft. In the middle photograph the weighted grapnel on the end of the hauling line has nearly reached the winch in the tanker. In the lower picture the end of the hauling line has been attached to the nozzle of the hose, which is beginning to emerge from the reel on the tanker. The cable is shown slightly thicker to make it discernible.





(Left) The hand-operated winch used for bringing the hauling cable on board the tanker. (Right) The nozzle of the hose pipe is shaped to fit the cone in the receiving aircraft, where it is held fast by hydraulically-operated toggles.

will undoubtedly come into use later when fully developed.

Quite early in his experiments Sir Alan Cobham became convinced that a fundamental condition of avoiding risk was that the hose should pass over no part of either aircraft. That meant that it should run from the nose of the tanker to the stern of the receiving aircraft, so that during the actual operation of transferring the fuel the two machines would be in the usual formation for best view, viz., with the tanker slightly above, slightly aft and slightly to one side of the other machine.

Simple Equipment

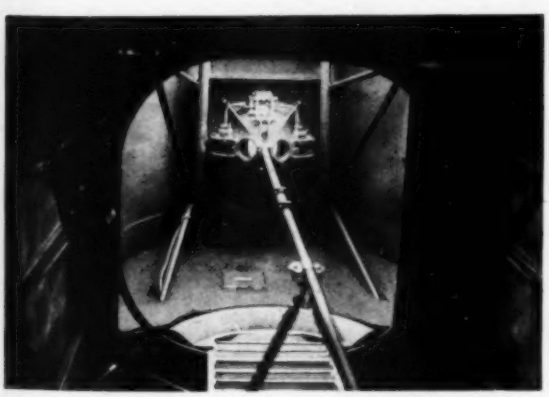
That decision to a considerable extent settled the general arrangement of the equipment. In the case of the aircraft to be refuelled it means that the cone which receives the hose must be placed in the extreme stern, pipe lines leading from it to the tanks in different parts of the aircraft. The only other fuelling equipment with which the receiving aeroplane must be equipped is a winch (hand- or power-operated) with which to let out the hauling line and pull in the hose.

In detail it is not, of course, quite as simple as all that. The pipe-line system has to be carefully considered, and a jettison system must be incorporated so that should there be an engine failure shortly after filling the tanks sufficient fuel can be jettisoned to enable the machine to fly on its remaining engines. Also, a system of valves must be incorporated which will prevent overflowing when any one tank fills up before the others. But there need certainly be nothing very elaborate about the equipment, particularly if the layout is incorporated in the design from the beginning.

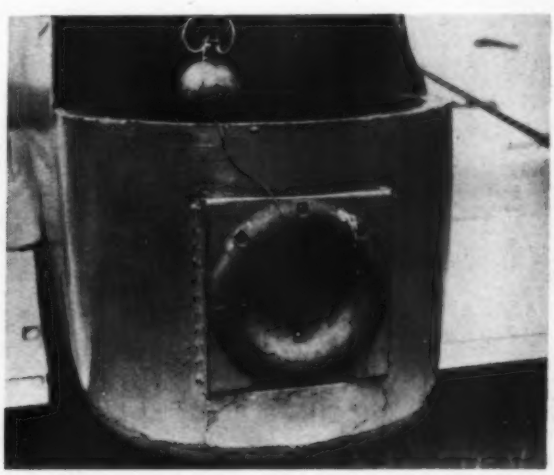
The equipment of the tanker must, of necessity, be a good deal more elaborate, but as the tanker will be flown by a pilot who is a specialist, and the equipment operated by highly trained crews, this elaboration does not affect the operating company. Nevertheless, although not essential to successful fuelling, it is obviously an advantage if the crew of the receiving aircraft are familiar with the essential details of the tanker's equipment. Better team work is likely to follow from such knowledge.

For the forthcoming Atlantic flights a number of Handley Page Harrow bombers have been lent by the Air Ministry and converted into tankers. Some of our photographs show certain equipment installed in one of them. Most important, apart from the additional tanks to bring the capacity up to the 1,000 gallons or so which the flying boats will take on board, are the winch for the hauling line and the large reel for the hose. At present, hand operation is employed, but a system of power operation is being developed, and in due course the work of handling the cables and hose will be reduced almost literally to pressing buttons.

On the day of our visit to Ford the Armstrong-Whitworth A.W.XXIII was being used as the receiving aircraft. Actually, it is used as a flying laboratory and can function



Inside the receiving aircraft : On the back of the cone are the toggles and their piping. The hauling line passes through the central tube to the winch. The petrol pipes run from the two flanges to the tanks, but were not in place when this picture was taken.



The cone in the stern of the receiving aircraft : The ends of the toggles can just be seen projecting through their slits. The weighted grapnel on the end of the hauling line is seen on top of the cockpit coaming. Note that the cable passes through the centre of the cone, into the pipe shown in the internal view on the left.

Sir Alan Cobham, managing director of Flight Refuelling, Ltd., in the pilot's cockpit of the Harrow which is used as a tanker.

alternatively as the receiver and tanker. The coupling in the stern is housed in what was the rear gun turret, and the hauling cable runs in a tube from the centre of the coupling towards the winch. The hauling cable terminates at its free end in a weighted grapnel, which, before fuelling, lies snugly in the cup of the coupling.

In the account which follows it will only be necessary to substitute for references to the A.W.XXIII mental pictures of the Short "C" Class boats in order to visualise how these will be fuelled for the Atlantic flights.

As already mentioned, the so-called "wing-tip system" of making contact will be used, and was used during our visit. The general principle of this system is that the tanker carries at its port wing tip a weighted grapnel attached to a line running to the cable winch in the forward part of the Harrow via a fairlead placed farther aft under the fuselage. This indirect path is necessary in order to make the cable clear the undercarriage, which is not retractable in the Harrow.

How it is Done

On the day of our visit the A.W.XXIII was piloted by Sir Alan Cobham, while the Harrow tanker was flown by Flt. Lt. Tyson. The writer was in the Harrow and the photographer in the A.W. After reaching the coast (most of the fuelling experiments are made over the sea), the A.W. began to let out her cable from the coupling in the stern. The weighted grapnel, of course, caused the cable to take up a curved downward path. Flt. Lt. Tyson flew the Harrow behind, below and to starboard of the A.W. On the first attempt the trailing cable just missed the wing tip, but in a matter of seconds a second attempt was made. The cable touched our leading edge a couple of feet from the wing tip, slid outwards to the tip and caught the grapnel of our line, which hissed out until it was trailing back from the fairlead farther aft in the fuselage, well clear of the undercarriage.

The winch crew on the Harrow then got to work and wound in the line until the receiver's grapnel came on board. This was then removed and the end of the cable fastened to the cone on the end of the hose. While this was going on we maintained a position slightly aft and above the A.W., and mostly on the starboard side, although at times we were partly above it. When the cable had been made fast to the hose pipe the winch crew on the A.W., at a signal from us, began to haul in the line, our crew in the meantime paying out the hose from the reel by judicious use of the brake. Gradually the length of cable trailing from the stern of the A.W. became shorter and the hose from the Harrow longer, until the coupling was home and secured.

We flew along for some minutes like that to simulate the fuelling. Actually, no fuel was transferred on this occasion, for the very good reason that the coupling in the stern of the A.W. had no pipe lines to its tanks, the machine having been used for a different experiment a short time previously. However, it was perfectly easy to visualise how a real fuelling operation is carried out. At a given signal the crew of the A.W. cast off the hose connection by opening the hydraulically operated toggles, our crew wound in the hose, and in formation we returned to Ford aerodrome.

From our observation at close quarters we are quite satisfied that Sir Alan Cobham's claim that he is ready to refuel the boats is justified. Any delay in getting on with the flights will not be his fault. And the difficulties encountered at the other end of the hose, so to speak, are not of such a nature that they are likely to do more than cause a postponement of the start. That is annoying, certainly, but not prejudicial to ultimate success.

And now for a few impressions, based upon personal experience of fuelling in the air and discussions with Sir Alan Cobham and the technical staff of Flight Refuelling, Ltd.

Making contact is, of course, the first step. There are many ways in which that can be done. One was shown at the last R.A.F. Display at Hendon and was developed by Sqn. Ldr. Atcherley at the Royal Aircraft Establishment. One aircraft trails its cable across that of the other machine and a grapnel holds the two together. Sir Alan Cobham's present system is, as already explained, the "wing-tip contact." Others can readily be visualised. It is, of course, even conceivable that the contact may be made before the machines even leave the ground. If tanker and receiver are of reasonably the same performance, as they have to be for fuelling in the air, there seems no good reason why they should not take off tied together. Fighters used to do that in the R.A.F. Display.

One Light, One Heavy

Then there is the actual transfer of the fuel. At the beginning of the operation the receiving aircraft will be light and the tanker heavy. In extremely bumpy weather that might cause some difficulty, because the lower aircraft will be hopping about while the tanker is sluggish. But there is reason to think that with practice it can be accomplished safely, and, anyway, the machines can go to a height at which the bumps are less severe.

Concerning the effect on the aircraft being refuelled, it can be said that the pilot is not normally aware that anything is happening. Owing to the fact that air resistance causes the hose to trail straight back from the stern for many feet, and to the curve in the hose, the pull is almost straight back, and only in the event of the two machines being thrown sufficiently far apart, by a gust or any other cause, will the hose pipe become anything like straight and taut. When that happens, the hydraulic toggles which lock the male and female parts of the coupling together release automatically, and the end of the hose falls clear of the receiving aircraft.

Finally, there is the question of fire risk. This can be classed under three headings. A broken pipe line would cause petrol to flow from the tanker at the rate of something like 150 gallons per minute. That sounds rather terrifying, but it should be remembered that the hose pipe enters the receiving aircraft at the extreme stern, and leaves the tanker near the nose, so that no part of the hose, even after a breakage, would be above either aircraft.

It is known that the friction of the petrol inside the hose might, under certain circumstances, cause trouble. To avoid any possibility of this rather remote risk arising it is proposed to flush the pipe line with an inert gas, which should effectively dispose of this cause. The difference in potential between the two aircraft which might exist at the moment of making contact can be looked after by careful bonding.

There remains the possibility of the two aircraft being struck by lightning. That may happen to any aircraft, and for safety in fuelling it will be necessary to make absolutely sure that there are no petrol fumes either outside or inside the aircraft. Careful "plumbing" should be capable of ensuring that.

The Story of a Yorkshireman's Pre-war Ventures and the Great Aircraft Business that was Born of Them : Famous Aircraft from the Blackburn Monoplane of 1910 to the Skua of To-day.

"WHILE testing his monoplane on the Marske sands on May 24, Mr. R. Blackburn, of Leeds, met with a mishap. He was running the machine along the beach when, through skidding into a hole, the tyre of one of the wheels came off. Mr. Blackburn at once cut off the ignition, and, as a result of the sudden stoppage, he was thrown from his seat. Fortunately he escaped injury, but the left wing of the monoplane was slightly damaged."

This paragraph, published on May 28, 1910, was the first reference in *Flight* to Mr. Robert Blackburn's activities. From that somewhat inglorious start it was difficult to foresee that one day the name would become world-famous. Yet the occurrence was one typical of the work of the pioneers. A short hop, a crash, a few weeks in the shed for repairs; and then the process was repeated. Such was the life of nearly every early constructor, and Robert Blackburn was no exception.

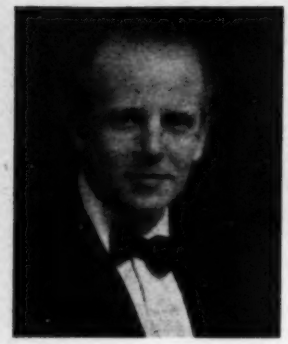
The Blackburn saga does not, however, begin in May of 1910. Long before that this young Yorkshireman had become interested in flying, mainly as a result of his travels and studies in Germany and France. In fact, the machine to which the historic paragraph referred was largely designed during one of Robert's stays in Paris. On his return to Yorkshire his father, who was managing director of the well-known firm of T. Green and Sons, Ltd. (general engineers, but

THE PRESENT HEADS OF THE BLACKBURN ORGANISATION.

Mr. Robert Blackburn, O.B.E., A.M.I.C.E., F.R.Ae.S., M.I.M.E., chairman and joint managing director.

Sir Maurice Denny, Bart., C.B.E., head of the famous shipbuilding firm now linked with the Blackburn interests at Dumbarton.

Major F. A. Bumpus, B.Sc., A.R.C.S., Wh.Sc., F.R.Ae.S., joint managing director with Mr. R. Blackburn.



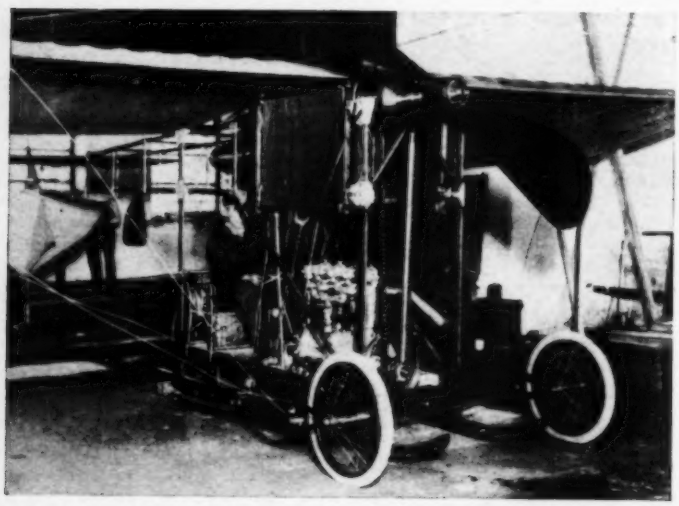
(Above) Mr. Robert Blackburn with his brothers Charles (standing at his right) and Norman. (Left) Mr. R. R. Rhodes and (right) Sqn. Ldr. J. L. N. Bennett-Baggs, both directors of the Blackburn company.

most popularly known through their lawn mowers) decided that Robert's enthusiasm for flying should be given an outlet, and he helped him to get his first aircraft works started. "Works" is something of a euphemism when applied to the first Blackburn factory, for it consisted of a single room underneath a small clothing factory in Benson Street, off North Street, Leeds. Robert had got most of his drawings prepared during 1908, and work on the building of the machine began early in 1909.

When the aeroplane was finished it was taken to the shore between Marske and Saltburn, and there Robert enjoyed himself by taxying up and down the sands. It is believed that he occasionally succeeded in making short hops, but the 35 h.p. Green engine was not really powerful enough for proper flight, and it was not very long before he scrapped the whole contraption. However, it had served its purpose by showing that Robert could design aircraft, and one may suppose that this influenced Blackburn Senior to continue his support.

The machine was original if it was nothing else. One might describe it as a three-wheeled motor car with a wing and tail attached. The pilot and the 35 h.p. Green engine were placed low over the ground on a sort of platform, and the wing, tail girder and airscrew were raised above this platform, transmission being by chain.

That Robert Blackburn had already ideas of his own in those early days is shown by the fact that on June 10, 1910, *Flight* recorded that he had patented a stability device which consisted of a pendulum-controlled compressed-air cylinder—the forerunner of the automatic pilot, in fact, though Robert did not know, any more than did anyone else, that pendulum control was unsuitable on account of its susceptibility to the effects of acceleration and deceleration.



The first attempt had an underslung chassis and chain drive from the 35 h.p. Green engine to the airscrew.

Robert Blackburn's three-roomed bungalow on the Filey cliffs.

B. C. Hucks flying machine No. 2 over the sands at Filey. The hangar was on top of the cliff, and a concrete slipway led down to the beach.

Robert never minded lending a hand. Here he is installing his first 50 h.p. Gnome engine.

Four old-timers who joined Robert Blackburn in the earliest days and are still with the company. Left to right: Mark Swann, Arthur Mason, Harry Goodyear and George Watson.

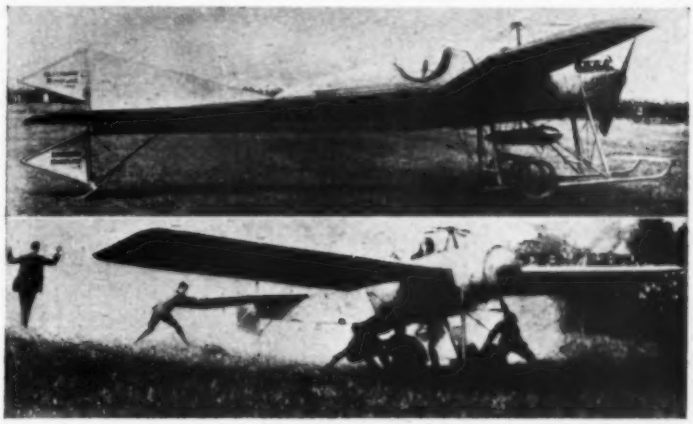
That Robert Blackburn was not content to copy others was shown by, among other things, the type of control he used in his first machine, a type which was retained in many subsequent Blackburn aeroplanes, until he finally had to bow to popular demand and adopt orthodox controls. The feet were not used at all, the entire control of the machine being done by the steering wheel. Turning of the wheel operated the rudder; moving the wheel bodily from side to side warped the wings (no one used ailerons on monoplanes in those days); and an up-and-down movement of the wheel actuated the elevator.

Whether his originality had strewn his path with too many obstacles or whether other influences caused a change of mind we do not know, but the next Blackburn aeroplane was completely different from No. 1. It was frankly based upon the French Antoinette design of M. Levavaseur, although it differed from it in almost every detail. This machine, which was known at first as the "light" model in contradistinction to the "flying bedstead," was also built in the room in Benson Street; at any rate, the bits and pieces were. This machine, a wire-braced monoplane with a fuselage of triangular cross-section and a wheel-cum-skid undercarriage, was fitted with another Leeds product in the form of a 40 h.p. radial air-cooled engine designed by one Mr. Isaacson, who was connected with the Hunslet Engine Company. In many ways this engine was ahead of its time. It was a stationary engine at a time when a rotary, the Gnome, was conquering the flying world. It had overhead valves, push-rod operated, and it had an airscrew reduction gear. The machine was taken to the Blackpool meeting in August of 1910, but did not take any part in the flying as the engine was not merely untried (that meant nothing in those days) but was not even quite finished, although it had been installed in the machine.

After the Blackpool meeting the undercarriage of the Blackburn monoplane was redesigned, and the machine was taken to Filey sands, where Robert had a hangar and a three-roomed bungalow. The hangar was on top of the cliffs, and a wide concrete slipway ran from it down to the sands. A winch was used for hauling the machine up after a flight.

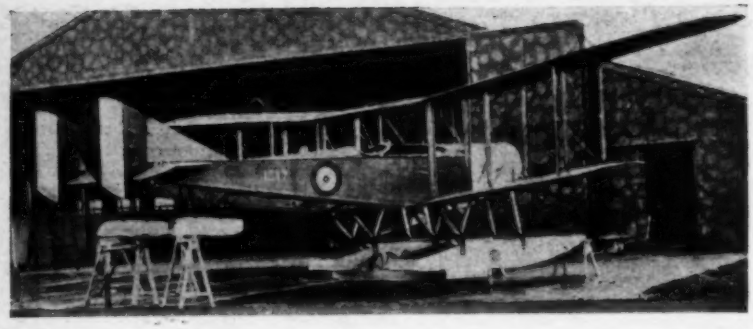
Round about this time there arrived a young man by the name of B. C. Hucks. He managed to persuade Robert Blackburn to let him try piloting the machine (he had previously been with Grahame-White at Hendon), and in due course he took his ticket on it and became a famous pilot, not only as a flying instructor but as an exhibition pilot. He toured the country with Blackburn monoplanes, and the present Editor of *Flight* recollects seeing him fly at Gloucester in what we considered a gale. That was in 1911.

During the early part of 1911 Robert Blackburn secured new premises at Balm Road, Leeds, and manufacture began in real earnest. Harry Goodyear, who had been with Robert from the very beginning, was joined by Mark Swann, and a little later by George Watson. All three, by the way, are still with the Blackburn company. The

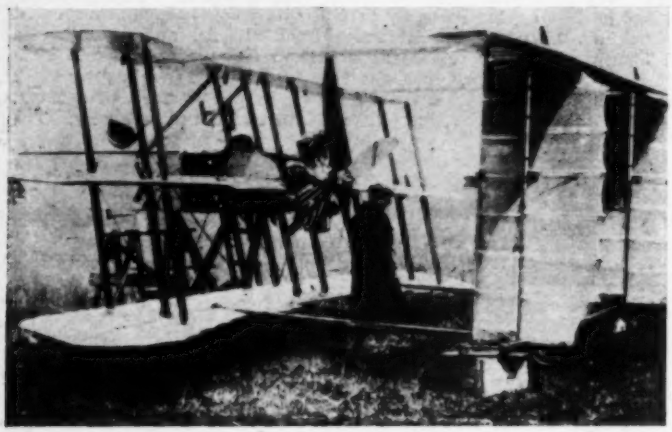


The upper picture shows the first Blackburn all-metal machine (1912); in the lower is seen a special fast 80 h.p. monoplane belonging to Dr. Christie (circa 1913).

The first Blackburn biplane (upper of the two pictures on the right) was built for the "Circuit-of-Britain" in 1914. It had a 130 h.p. Salmson radial water-cooled engine. The little mono-seaplane below it was used at the flying school on Lake Windermere from 1915 onwards.



In 1915 appeared the "T.B." twin-fuselage seaplane (left). It was originally designed for dropping steel darts. Below it is the most remarkable Blackburn aeroplane ever produced, the little triplane single-seater fighter pusher.



Blackburn monoplane was now named the Mercury. An example, still with the Isaacson engine, was exhibited at the Olympia Aero Show of 1911. A characteristic feature of the machine was that it had a one-piece elevator, and the rudder was split into two small triangles, one above and one below the elevator. The undercarriage was generously strutted to resist the efforts of inexpert pupils. Although he had done much flying on the machine, it was not until May, 1911, that Hucks obtained his ticket on it. He was entirely self-taught, as were of necessity most of the earliest pilots.

The great "Circuit-of-Britain" air race for the *Daily Mail* prize of £10,000 was flown in July, 1911, and two Blackburn monoplanes were entered. One was piloted by B.C. Hucks and the other by Conway Jenkins. The latter crashed at Brooklands at the start of the race, and Hucks only got as far as Luton, where he damaged his machine. Both aircraft, by the way, had been fitted with 50 h.p. Gnome rotaries instead of the original Isaacson.

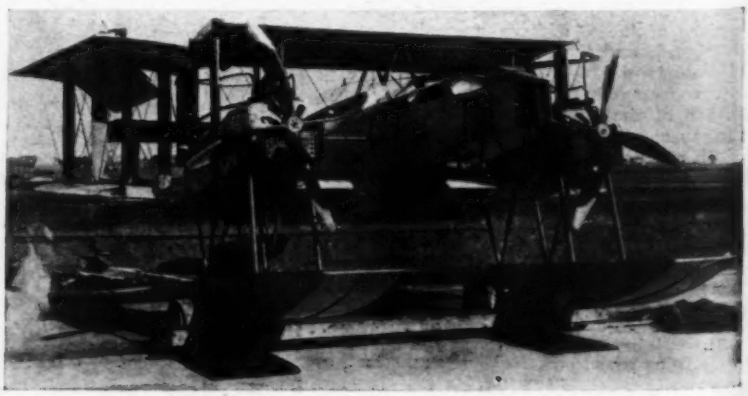
In this connection it is of interest to recall that Robert Blackburn produced what was probably the first British-designed and British-built all-metal aeroplane. The general design was similar to that of the Mercury, triangular-section fuselage and braced monoplane wings, but the structure was steel tubing. The machine, the design of which began in 1911, had been intended for the military aircraft competition of 1912, but was not finished in time to take part. It was fitted with a 70 h.p. Renault vee-eight air-cooled engine.

In the meantime the Blackburn school had been transferred from Filey to Hendon, where Mr. (now Wing Commander) Harold Blackburn was in charge. Harold Blackburn, contrary to general belief, is not related to Robert Blackburn. Much good work was done there, and many pupils were taught who afterwards became famous in British aviation.

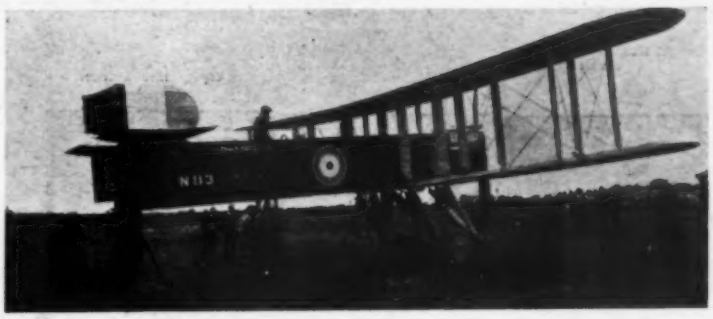
Early in 1913 a new single-seater monoplane was produced to the order of Cyril Foggin. Harold Blackburn tested it, and then the owner took it over, finding it very satisfactory. With a 50 h.p. Gnome it had a speed of about 60 m.p.h., which was considered fast in those days. The general design resembled that of the Mercury class, but the tail differed in having a one-piece rudder and divided elevator. The skid-cum-wheel undercarriage was retained. A two-seater version appeared in the summer of 1913. It was fitted with a Gnome rotary engine of 80 h.p., and did 70 m.p.h. It was sold to Dr. Christie, who did a great deal of flying in it as a passenger, the pilot being Harold Blackburn. On it was won the aerial "War of the Roses" for a trophy presented by the *Yorkshire Evening News*. Lancashire was represented by F. P. Raynham on an Avro biplane (type 504).

In *Flight* of July 31, 1914, we find the following paragraph: "*Blackburn Aeroplane and Motor Co., Ltd.*—Capital £20,000, in £1 shares. Acquiring the business of an aeroplane designer and constructor carried on by R. Blackburn as the Blackburn Aeroplane Co. First directors, R. Blackburn and J. E. Jackson." That was the beginning of the Blackburn firm as a limited company. Up till that time Robert had financed the whole thing himself (aided, one may suppose, by Blackburn, Senior).

It should be observed that up till the beginning of the war all Blackburn machines had been monoplanes. In 1914 Robert changed over to the biplane type, not so much because he had lost faith in the monoplane type, but the products of certain other designers had sustained a number of breakages, which resulted in monoplanes being officially banned in England for a time. The 1914 Blackburn biplane was designed for the *Daily Mail* "Circuit-of-Britain" seaplane race, which was cancelled by the outbreak of war. The first Blackburn biplane, which was to have been piloted in the race by Mr. Sidney Pickles, had a strong family resemblance to the Backburn monoplanes, but the triangular fuselage had given way to one of rectangular cross-section, and the engine was a Salmson-Canton Unne radial water-cooled of 130 h.p. The machine was taken



The Blackburn "G.P." type, with two 225 h.p. Sunbeam engines, was produced in 1916 and became the forerunner of the later-famous Kangaroo. It is interesting to note that wing-folding was used thus early.



The Blackburn Kangaroo, developed from the "G.P.," was designed for night bombing and anti-submarine patrol. Shown here is a post-war civil version, operated for a time by the Grahame-White company. The Blackburn Blackburd (in the lower view) was the first machine to be specifically designed for carrying a torpedo.

over, as were all the other seaplanes built for the race, by the authorities. It was fitted with a machine gun and then became known as the "Type L."

Towards the end of 1914 the Blackburn company took over their new works at Olympia, Leeds, and here were built considerable numbers of aircraft during the war period, some of Blackburn's own design but many more of other firms' designs, such as Sopwiths and B.E.2 Cs.

In 1915 appeared a little twin-float monoplane with 100 h.p. Anzani engine. It was bought by the Northern Aircraft Co., which operated a seaplane school on Lake Windermere. Here the machine did a great deal of flying, piloted by Mr. Rowland Ding. The machine was known as the Land/sea Monoplane Trainer from the fact that it was available in both forms, the substitution of wheels for floats being a simple matter.

The first "seriously military" effort of the Blackburn company during the war was known as the "T.B." Built to Admiralty requirements (originally for dropping darts), it was a twin-engined, twin-fuselage, twin-float seaplane with biplane wings. A better designation might, in view of the fact that the machine had two of everything, been the T.E. However, it was quite a good seaplane, and its performance, in spite of two fuselages and two floats, was by no means bad, with a top speed of 86 m.p.h. and a climb to 5,000ft. in 12 minutes. The engines were 100 h.p. Gnome *Monosoupapes*. The second machine was fitted with two 110 h.p. Clergets. The "T.B." made its appearance in August, 1915.

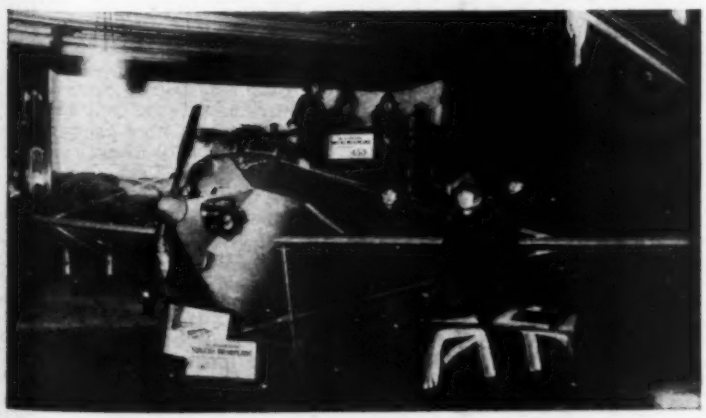
Then came perhaps the weirdest aeroplane the Blackburn company has ever turned out. It was a triplane pusher with 100 h.p. Gnome *Monosoupape* (single-valve to you!). When this machine appeared, the use of synchronised machine guns firing through the airscrew disc had not become general, and the idea was to give the pilot a good field of fire for his front gun. The pusher type was always considered inferior to the tractor for sheer speed, and so the Blackburn triplane did not go into production. It had a speed, with 100 h.p. engine, of about 115 m.p.h.

Although the "T.B." did not reach the production stage the advantages of two engines had been demonstrated by that machine, and so it was not surprising that by the middle of 1916 another Blackburn twin-engined type should appear. This was known as the "G.P.," and had a long central fuselage, with two Rolls-Royce engines of 190 h.p., each mounted on the lower wing. Later, the Rolls-Royce Falcon engine, of 250 h.p., became available, and the later "G.P.s" were fitted with these engines. The machine carried machine guns and bombs, and was also designed to carry a torpedo if desired.

As a seaplane the "G.P." did not go into large production, but a landplane version, which became known as the Kangaroo, was produced in considerable numbers. It had a range of about 600 miles, cruising at approximately 100 m.p.h., and was used for night bombing and for anti-submarine patrol. After the war it was converted into a commercial aeroplane, and did a certain amount of survey work as well.

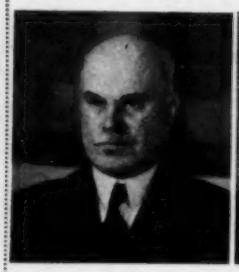
Designed to an Admiralty specification, N.1 B., a small single-seater flying boat fighter, was laid down in 1917. Not unnaturally, the specification letters resulted in this machine becoming known as the "NIB." It was intended to act as escort to the large flying boats, and was to be powered by a 200 h.p. Hispano-Suiza engine. Owing to certain changes in Service requirements the machine was never completed in its original form, but a modified version, known as the Pellet, was entered for a Schneider Contest at Cowes. There it porpoised and turned turtle with its pilot, Reggie Kenworthy. One of our pictures shows the machine a few moments before that emotioning event.

Mention has been made of the fact that the "G.P." and Kangaroo biplanes could, if necessary, carry torpedoes. They were, however, bombers first and foremost. The first Blackburn machine to be specifically designed for torpedo-carrying was the Blackburd (spelt with a "u") which appeared in 1918. By this time the first aircraft carrier, the *Argus*, had come into being, and the Blackburd was designed to operate from her. In order to make this possible a somewhat unusual undercarriage arrangement had to be schemed out. The machine was intended to take off from the deck on its wheels, but

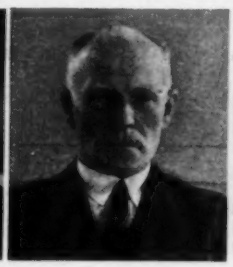


The Blackburn Sidecar produced in 1920 was a side-by-side two-seater. It had a 40 h.p. A.B.C. Gnat engine.

SOME "HEADS" of BLACKBURN AIRCRAFT



E. HUDSON, F.C.I.S., director.

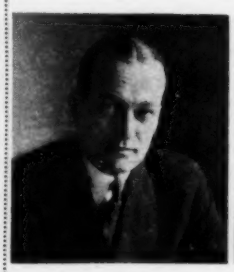


W. W. MacARTHUR, M.I.Mech.E., M.I.P.E., general works manager.

W. D. MURRAY, A.F.R.Ae.S., deputy chief engineer.

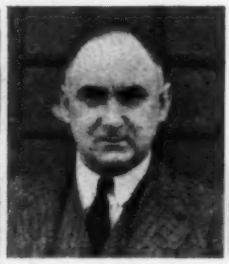
G. E. PETTY, F.R.Ae.S., chief designer.

Major J. D. RENNIE, F.R.Ae.S., A.R.T.C., A.M.I.C.E., chief seaplane designer.



H. J. STIEGER, D.I.C., A.F.R.Ae.S., chief of research and development.

Flt. Lt. H. BAILEY, A.M.I.C.E., A.F.R.Ae.S., chief test pilot.



J. HALL, production designer.

D. B. NIVISON, M.I.P.E., works manager.

H. O. LEVICK, experimental-works manager.

S. WALKER, A.M.I.Mech.E., chief plant engineer.

A. McCULLOCH, M.I.E.I., chief inspector.

F. W. BUGLASS, chief production engineer.

J. T. ORMEROD, chief jig and tool designer.

V. S. GAUNT, F.R.Ae.S., A.M.I.P.E., night works manager.

T. BANCROFT, chief ground engineer.

Sqn. Ldr. A. A. LOTON, A.F.C., chief instructor.

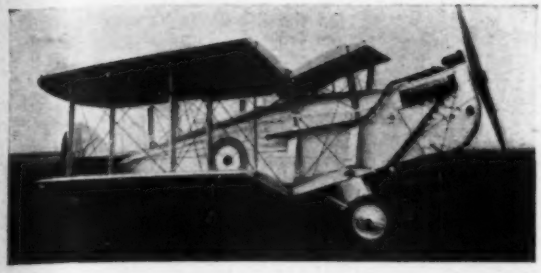
modern arrester gear was not then available, and provision was consequently made for landing on a pair of skids, the wheels of the undercarriage being dropped. It was also thought that if the machine should be forced to alight on the sea the skids would not be so likely to trip it up as would the wheels. The engine fitted in the Blackburd was the Rolls-Royce Eagle of 350 h.p. With this engine the machine had a speed of 95 m.p.h.

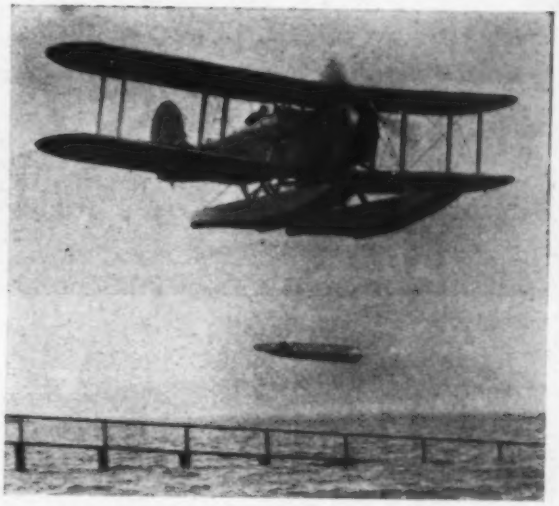
Mention has been made of the fact that during the war period the Blackburn company built numerous machines of other firms' design. In addition to Sopwith Baby seaplanes and B.E.2 Cs, the company also took over the completion of the Sopwith Cuckoo design and its subsequent construction. Altogether, 80 of these machines were built by the Blackburn firm. The engine was a 200 h.p. Hispano-Suiza, and, in view of the great load to be lifted (an 18in. torpedo), the wing span was large, and a three-bay biplane arrangement was used.

After the war the Blackburn Company began to interest itself in civil aviation. The first step was to convert a number of Kangaroos into commercial aeroplanes, and a beginning was made in connection with the E.L.T.A. Aero Show at Amsterdam in 1919, when many passengers were carried. A Blackburn Kangaroo left Hounslow on November 21, 1919, on the England-Australia race flight. The North Sea Aerial Navigation Company was formed as an offshoot of the Blackburn Company to look after the commercial aviation side, and among its other activities may be mentioned a survey of the England-to-South Africa air route.

While mainly interested in the commercial side of aviation, the firm did not lose sight of the sporting side, and in 1920 was produced the little Blackburn Sidecar, a small side-by-side monoplane with 40 h.p. A.B.C. Gnat engine.

Returning to the war craft side we may observe that the Blackburn Company merits particular praise for the





The Dart was used in the Fleet Air Arm for many years as a single-seater torpedo carrier. Training versions were two-seaters. On the right is the Velos two-seater.

brilliant fashion in which it has tackled appallingly difficult specifications, notably for naval aircraft, which have always been notoriously "awkward" to design.

The Blackburd demonstrated the potentialities of the torpedo-carrying aircraft, but left a good deal to be desired, particularly in the matter of performance. Blackburn's next torpedo machine was a very distinct advance, and was, in fact, the prototype of a series of aircraft which were retained in service until quite recent times. This was the Swift, produced in 1919, which retained the "releasable" wheels which characterised the Blackburd. Structurally, it was interesting because the whole centre portion, including the engine mounting, the middle portion of the fuselage, the undercarriage and the centre sections of the biplane wings, was a framework of steel. The engine was a 450 h.p. Napier Lion, and the machine was a single-seater. As a ship-plane the Swift carried flotation bags and slinging gear and had folding wings, despite the fact that these were staggered. After being shown at Olympia, Swifts were ordered by many of the leading nations, including America.

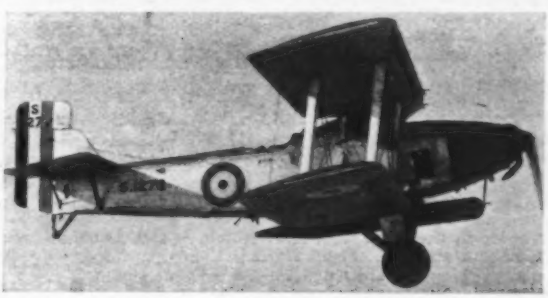
Fitted with a 1,000 h.p. Napier Cub, the Cubaroo was one of the largest single-engined machines ever built.

F.A.A. *Equipment*

Encouraged by the success of the Swift, the Blackburn designers set about improving the type, the developed version being named the Dart. The first Dart appeared in 1920, and was subsequently ordered as standard equipment for Fleet Air Arm use. It remained in service until it was superseded in 1928 by the Ripon, also a Blackburn product.

The Dart was externally very similar to the Swift, and employed the same type of engine. It had a top speed of 106 m.p.h., weighed 6,300 lb. complete with torpedo, and had a ceiling of 15,000ft.

In the first instance the Swift and Dart were designed primarily as torpedo carriers, but slight alterations enabled them to carry a bomb load roughly equivalent to the weight of the "tin-fish." The next development was the fitting of an alternative float undercarriage. Later, the Dart type was developed into a Velos, which was ordered in quantity by the Greek Government. The salient difference between this machine and its forerunners was the inclusion of a gunner's cockpit which could alternatively be fitted with dual control.



The two views above show the original Ripon torpedo bomber (top) and the metal Mark III version.

Powered with a geared Jupiter, the Beagle torpedo bomber embodied many typical Blackburn features.

Just before the Velos was developed, the company completed an extraordinarily large coastal defence biplane mounting a single 1,000 h.p. Napier Cub engine. This was dubbed the Cubaroo, and by the summer of 1924 had proved itself in the air. It had a fuselage of quite enormous size, and could carry either a torpedo weighing a ton and a half or an equivalent load of bombs. The tail

Similar in that both were built with a watertight monocoque fuselage, the Shark and the M.1/30A above it, employed, respectively, the Siddeley Tiger and the Rolls-Royce Buzzard.

On the left Baffin torpedo bombers are seen in service with the R.A.F. Below them is seen the 3.M.R.4, built for Japan. It had a Hispano-Suiza engine.

was of biplane formation and the main undercarriage had four wheels. A Beardmore Simoon engine was fitted experimentally, but the Cubaroo will be chiefly remembered because it was powered with the first X-shaped Napier Cub.

By 1928 the company had developed the machine which was to supersede the Dart as the standard torpedo bomber of the Fleet Air Arm. Known as the Ripon, this aircraft was a single-bay biplane, with a 570 h.p. Napier Lion XI engine, capable of a top speed of about 132 m.p.h., and having an absolute ceiling of 15,000ft. A two-seater, the Ripon mounted two machine guns, and as an alternative to its torpedo could carry a bomb load of 1,000 lb. Although a seaplane version was built, the Fleet Air Arm used the Ripon mainly as a deck-landing machine. Finland acquired Ripons with Jupiter engines and built the type under licence at Helsinki.

In effect, the Ripon was the forerunner of the T.S.R. biplanes (typified by the Blackburn Shark as at present in service), having accommodation for an extra fuel tank for long-range reconnaissance. The original Ripon was of composite construction, but a subsequent machine—the Ripon III—was entirely of metal with fabric covering. The Ripon layout was adopted for the Beagle which was built to take a geared Jupiter VIII.

The Japanese Government acquired a two-bay machine having many of the characteristics of the Beagle but fitted with an Hispano-Suiza water-cooled engine. This was known as the 3.M.R.4, and had a maximum speed of 135 m.p.h. when flying at an all-up weight of 7,500 lb.

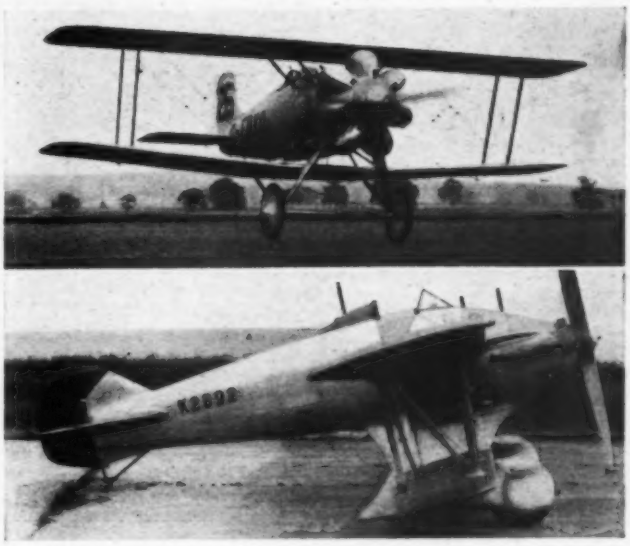
At the request of the Air Ministry the company next installed one of the new Bristol Pegasus engines in a machine which resembled the Ripon. The improved type was known as the Baffin, and remained a standard type in the Fleet Arm until very recently. Many ex-Fleet Air Arm Baffins are being supplied to New Zealand.

A Fast Torpedo Bomber

In 1930 an Air Ministry specification was issued for a comparatively large torpedo bomber machine to take the Rolls-Royce Buzzard engine. The Blackburn company submitted the M.1/30, which in some ways resembled an enlarged Ripon, and which was developed into the M.1/30A, which featured a watertight metal monocoque fuselage and had a top speed of 160 m.p.h. As an alternative to the torpedo, a bomb load of no less than 1,900 lb. could be accommodated. The Air Ministry decided to abandon the specification, and further development of the machine was suspended.

The most remarkable feature of the M.1/30A—the watertight metal monocoque fuselage—was reproduced in the Shark, which to-day equips a number of torpedo-spotter reconnaissance units of the Fleet Air Arm. The Shark is a two-bay biplane with wings of unequal span and having rigid bracing. The wings may be folded with the bombs in place, greatly facilitating the work of the armourers on board a carrier. The standard power plant is the Armstrong Siddeley Tiger, though Bristol Pegasus engines are fitted in the Sharks which have lately been supplied to Canada. The newest version has a cockpit enclosure and certain other improvements. Operating with a land undercarriage, the Shark has a top speed of about 152 m.p.h., and weighs over 7,800 lb. A service ceiling of 16,400ft. is attainable, and the normal cruising range is 550 miles. The Navy, which, incidentally, has never been without Blackburn aircraft since the war, is also indebted to the company for some Fleet spotter aircraft of bold design. In 1923 the Blackburn Blackburn was introduced for gunnery spotting and reconnaissance work. It bore a close relationship to the Dart, and, though unappealing from the æsthetic viewpoint, gave admirable service with the Fleet. In the first version of the Black-

The Blackburn Mk. II (left) was designed for spotting in comparative comfort. On the right is the Airedale monoplane spotter.



The intriguing little Lincock light fighter, seen in the photograph immediately to the right, had a very creditable performance considering its low power.

burn the fuselage connected directly with both upper and lower planes; in the Mark II version the gap between the wings was increased and the wing petrol tanks were eliminated. A crew of four was accommodated in the capacious fuselage, and when the machine was fitted with a seaplane undercarriage it could still be landed on the deck of a carrier thanks to special keels on the floats.

An Early Naval Monoplane

It is commonly believed that the Blackburn Skua fleet fighter dive bomber now in service with the Fleet Air Arm is the first naval monoplane to be built in this country. This is not the case, for in 1926 the company built the Airedale, an experimental three-seater fleet-spotter having a strut braced high wing of thick section. The outlook for the pilot was extraordinarily good, as he was placed in front of the leading edge. The engine of the Airedale was a 385 h.p. Armstrong Siddeley Jaguar driving a metal airscrew.

The name Blackburn is not usually associated with single-seater fighters, but the company, in 1928 built an outstandingly successful little biplane fighter known as the Lincock. Although a cleaned-up metal version was developed, the first Lincock was of wooden construction, and was characterised by the gap between the fuselage and the lower wing. The machine was classed as a light fighter, and, fitted with an Armstrong Siddeley Lynx Major engine of only 250 h.p., had a top speed of over 160 m.p.h., an initial rate of climb of 1,470ft./min., and reached a service ceiling of 22,000ft. Full military equipment, including two Vickers guns, was installed. One version of the Lincock had its Lynx engine fitted with a helmeted cowling, but this was displaced by a more conventional installation.

Pilots who flew it said that the Lincock was one of the nicest aerobatic machines imaginable. In the hands of Flt. Lt. Atcherley one of these delightful little biplanes demonstrated its prowess in America.

To a specification issued in 1930 a remarkable four-gun biplane was built. This was fitted with a Rolls-Royce Goshawk III engine. The pilot, thanks to the unusual arrangement of the biplane wings, had a fine field of view, particularly in an upward direction.

Although designs had been prepared soon after the war for transport aircraft, the first commercial machines of any consequence to be built appeared in 1932. These were the subject of a most unusual experiment. Both carried a crew and ten passengers, and each incorporated the same type of fuselage, tail unit, undercarriage and power plant (two 400 h.p. Siddeley Jaguars), but the great difference was that one machine was a biplane and the other a strut-braced, high-wing monoplane. Comparative tests provided some extraordinarily interesting data. At a loaded weight of 12,145 lb. the biplane was a shade slower than the monoplane, which was, of course, rather heavier.

At about the same period the Blackburn Segrave four-seater cabin monoplane was flying. This machine was of very advanced design, and with two engines of 120 h.p. each reached a top speed of 138 m.p.h. An aircraft of this type was in later years fitted experimentally with a Duncanson type wing built round a single tubular spar.

The same sort of wing construction was used for a larger

Built for comparative experiments, the Blackburn civil monoplane and biplane had a pair of Jaguars each.

Fitted experimentally with a Duncanson tubular-spar wing, the Blackburn Segrave (left) was of advanced conception. The H.S.T.10 transport, seen below it, was powered with two Napier Rapiers.

high-performance transport known as the H.S.T. 10. This machine was of modern conception, and was designed for a pair of sixteen-cylinder Napier-Rapier engines which gave it a top speed in the neighbourhood of 200 m.p.h. Pressure of work on the military side retarded development, and the type was not put into production.

The company was among the first to anticipate the popularity of the private-owner type of aircraft. In 1924 appeared the first Bluebird, a two-seater with dual control, the seats being arranged side by side. The Bluebird was produced originally for the *Daily Mail* competition at Lympne, but engine trouble prevented participation.

Sport

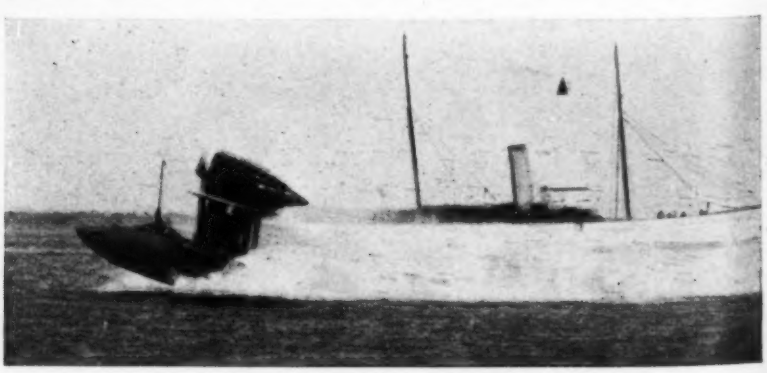
Later, fitted with an Armstrong Siddeley Genet and flown by Sqn. Ldr. W. Longton, it won the Grosvenor Cup in 1926. By the time the Bluebird had been developed to the "Mark IV" stage it was of metal construction, and was fitted with engines of comparatively high power. In view of the popularity of the side-by-side seating arrangement, the company retained this feature in its B-2 private-owner or training biplane which to-day is giving admirable service. A characteristic feature is the metal-clad fuselage.

Apart from the B-2, the company has produced a surprising number of training aircraft, largely adaptations of torpedo machines with wheel or float undercarriage. Perhaps the most interesting was the Sprat, built primarily for deck-landing training. This resembled in many respects the larger torpedo machines, and was fitted with a 270 h.p. Rolls-Royce Falcon engine.

Immediately above is the original Bluebird with Blackburn engine; above it is Mrs. Victor Bruce's long-distance Bluebird in which she flew 19,000 miles.

For the 1923 Schneider contest a flying boat of very distinctive appearance was constructed. This was a biplane known as the Pellet, and fitted with a 450 h.p. Napier Lion engine. The machine did not take part in the race as it was accidentally wrecked beforehand during the "navigability" tests.

Apart from the Nib, the Pellet was the first Blackburn flying boat. In 1924 the company started to design a large three-engined boat which, as the Iris I, was completed in 1927. This machine had a wooden hull and three Rolls-Royce Condor engines. Later developments led to the fitting of the greater portion of the original superstructure to a metal hull, the resulting machine being known as the Iris II. It was an Iris II that was used in 1927 as flagship



The Pellet flying boat was a racing machine built for the Schneider contest. This aircraft met with an accident just after the above photograph was taken and did not participate in the race.

The Dart torpedo carrier (above) was adapted as a seaplane trainer for Reserve use. Upper right is the Falcon-engined Sprat for deck-landing training and below it is the B.2 as now in use at certain R.A.F.V.R. centres for *ab initio* work.

during the Baltic Cruise of British flying boats, carrying Sir Samuel Hoare. In 1928 an Iris was used by Sir Philip Sassoon on the greater part of his 17,000-mile tour to India and back.

The Iris III was generally similar, and had a top speed of 105 knots and an endurance at cruising speed of nearly 12½ hours. Iris IV was an experimental development with three Armstrong-Siddeley Leopard engines, the centre one driving a pusher propeller.

The next type (Iris V) used three Rolls-Royce Buzzard engines of 825 h.p. each. This, in turn, was developed into the Perth, which carried a 37 mm. shell-gun on a special mounting in the bow.

The Sydney flying boat, the development of which coincided more or less with that of the later Irises, was an impressive three-engined monoplane, using Rolls-Royce Kestrels. The hull followed Iris practice, and the wing featured duralumin box spars. Development of the Nile, a similar machine fitted with Jupiter engines and intended for civil operation, was discontinued, although the hull of this machine was exhibited at Olympia in 1929.

At the time of writing the company is believed to be developing a very fast flying boat. In this connection it may be recalled that it holds patent rights for a retractable planing bottom.

To the order of the Air Ministry the company completed in 1929 a two-seater fleet fighter reconnaissance biplane known as the Nautilus. This was a two-bay machine with swept-back wings and a Rolls-Royce Kestrel engine. The Nautilus was never adopted as standard equipment, though the Roc monoplane, which was intended for somewhat similar duties, is now going into service.

The Roc is a development of the Skua, with which type we may conveniently deal first.

The Skua is the first monoplane to be adopted as standard for Fleet Air Arm use. It is a low-wing monoplane with a watertight monocoque fuselage and a tail unit of unusual layout, the fin and rudder being placed forward of the horizontal surfaces. Duties are primarily dive bombing and fighting, and the machine has folding wings and arrester gear for carrier operation.

The prototype Skua was fitted with a Bristol Mercury engine but the production machines, as now being delivered to Fleet Air Arm squadrons, have the sleeve-valve Perseus unit, the easy maintenance of which will prove a boon for carrier operation. The engine is enclosed in the standard Bristol long-chord cowling with single-outlet exhaust collector and controllable cooling gills, and the airscrew is a three-bladed variable-pitch De Havilland.

From top to bottom are the original wooden-hulled Iris I (R.-R. Condors), the Mk. IV Iris with Siddeley Leopards (the centre one drives a pusher propeller) and the Perth (R.-R. Buzzards) with a 37 mm. shell-gun.

Of advanced design, the Sydney military flying boat had three Rolls-Royce F (Kestrel) engines.

Produced for a two-seater fleet fighter competition the Nautilus (below) also had a Kestrel. Below it is the new Roc with Perseus engine.

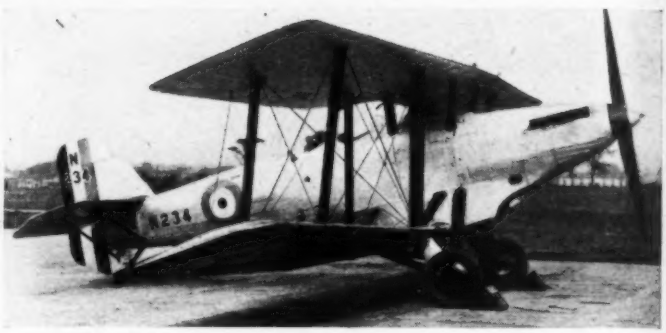
The Skua's wings are of stressed-skin construction and fold about inclined hinges on the centre section in such a fashion that they twist during the folding operation and lie alongside the fuselage with their leading edges uppermost.

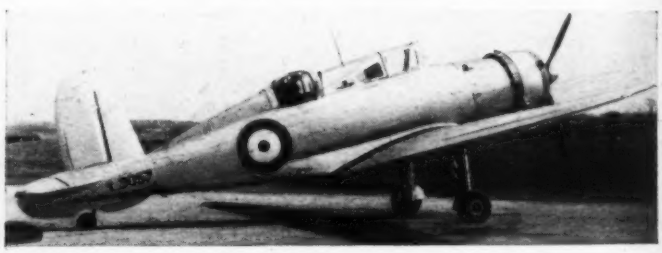
Special flaps are fitted not only to improve take-off and landing characteristics but to limit the speed of the machine in a bombing dive, permitting closer approach to the target and improving accuracy. These flaps are of somewhat unusual design and are set in troughs forward of the trailing edge. Like the fuselage, the wing has watertight compartments.

The undercarriage comprises two outwardly retracting units embodying oleo pneumatic springing and hydraulic retraction.

Performance figures for the Skua are not yet available, but the main dimensions are as follows: Span, 46ft. 2in.; length, 35ft. 7in.; width, folded, 15ft. 6in.; and height, 12ft. 6in.

Except for the faired multi-gun turret the Roc two-seater fighter (which, although of Blackburn design, is being built by the Boulton Paul concern at Wolverhampton) is generally similar to the Skua.





(Below) A two-seater dive-bomber fighter for Naval use, the Skua is already in service in considerable numbers.

The King's Air Force

A REALLY exceptional amount of facts and data on the R.A.F., methods of entry, work, training and equipment, is consolidated in *The King's Air Force*, published at sixpence by the Amalgamated Press, Ltd., The Fleetway House, Farringdon St., London, E.C.4. This 64-page book, in illustrated-journal style, has Air Ministry approval.

Wilbur Wright Memorial Lecture

THIS evening, at the Institution of Mechanical Engineers, Dr. George W. Lewis will deliver the 27th Wilbur Wright Memorial Lecture, entitled "Some Modern Methods of Research in the Problems of Flight." Dr. Lewis is the Director of Aeronautical Research, National Advisory Committee for Aeronautics of America.

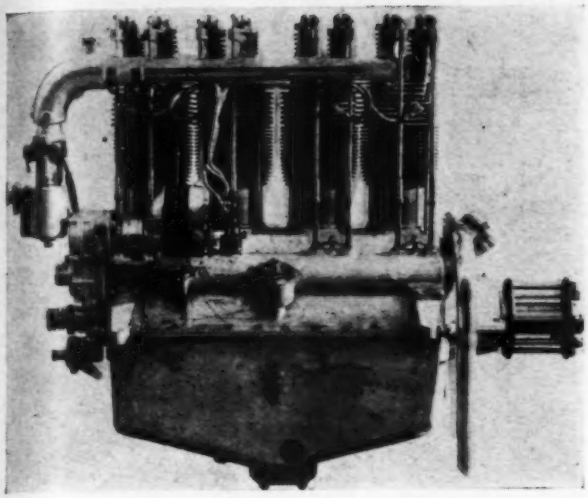
Dr. Lewis begins his lecture with some remarkable pictures and details of the research work carried out by the Brothers Wright before they made their historic flight on December 17, 1903. The lecture, which is illustrated by a film, continues with a description of modern wind-tunnel technique.

"The Aircraft Engineer"

OWING to extreme pressure on space our *Aircraft Engineer* supplement is unavoidably held over until next week, June 1.

Keeping Up With Demand

THE MOLLART ENGINEERING CO., LTD., Kingston By-pass, Surbiton, Surrey, state that despite the difficulties of obtaining machine tools to cater for the increased production of their patent universal ball joints for the aircraft industry, they anticipate that with the addition of new equipment and running a three-shift system they will be able to cater for the increased demand in the very near future.



In 1925 the Cirrus Mark I made its bow to the public, producing a proud 65 b.h.p. at 2,000 r.p.m. for a total weight of 260 lb.

Another Chapter in Blackburn History —The Cirrus Engine Side : New Major 150 Described

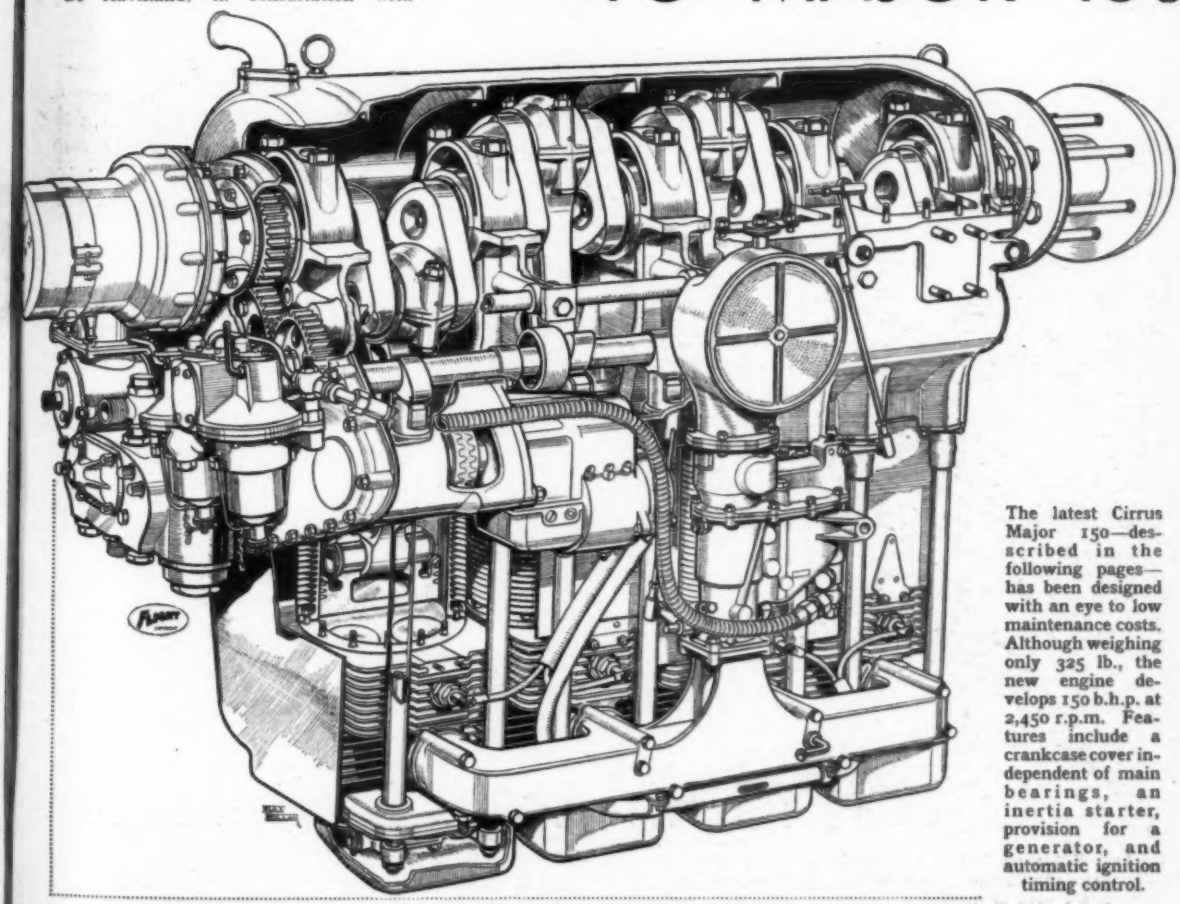
FROM MARK I—

DURING the early 'twenties one of the chief topics of aeronautical conversation concerned the question of aircraft suitable for the private owner and for the clubs. In the main, light aeroplanes—light in every sense of the word, with small 30 h.p. engines—were accepted as the coming thing, but, in spite of popular opinion, Capt. Geoffrey De Havilland, in consultation with Major F. B. Halford, decided to break away from the accepted ideal of 1924 by designing a comparatively heavy and robust light aircraft in the form of the De Havilland Moth. Major F. B. Halford's part was played in connection with the engine.

At that time the Aircraft Disposal Co., of Waddon, Croydon, was producing the 120 h.p. Airdisco engine, which was in turn one of Major Halford's modifications of the 80 h.p. Renault engine. Capt. De Havilland suggested to Major Halford that it should be possible to provide a moderately powerful engine unit for his Moth by using four of the Airdisco's cylinders and various other components to make a reliable, if somewhat heavy, engine.

The result was that in 1925 the Aircraft Disposal Co. produced the first of a long series of Cirrus engines, designed specifically for use in aircraft of the private-owner and club type. That engine developed 65 b.h.p. at 2,000 r.p.m. for a weight of 260 lb. The following year saw the introduction of the Cirrus Mark II, which was a logical improvement on its predecessor. By increasing the bore by 5 mm. and making other modifications, particularly in connection with the cylinder heads and the crankshaft, the performance was increased to 84 b.h.p. at 2,000 r.p.m..

—TO MAJOR 150



The latest Cirrus Major 150—described in the following pages—has been designed with an eye to low maintenance costs. Although weighing only 325 lb., the new engine develops 150 b.h.p. at 2,450 r.p.m. Features include a crankcase cover independent of main bearings, an inertia starter, provision for a generator, and automatic ignition timing control.

while in weight the new engine was only 8 lb. heavier.

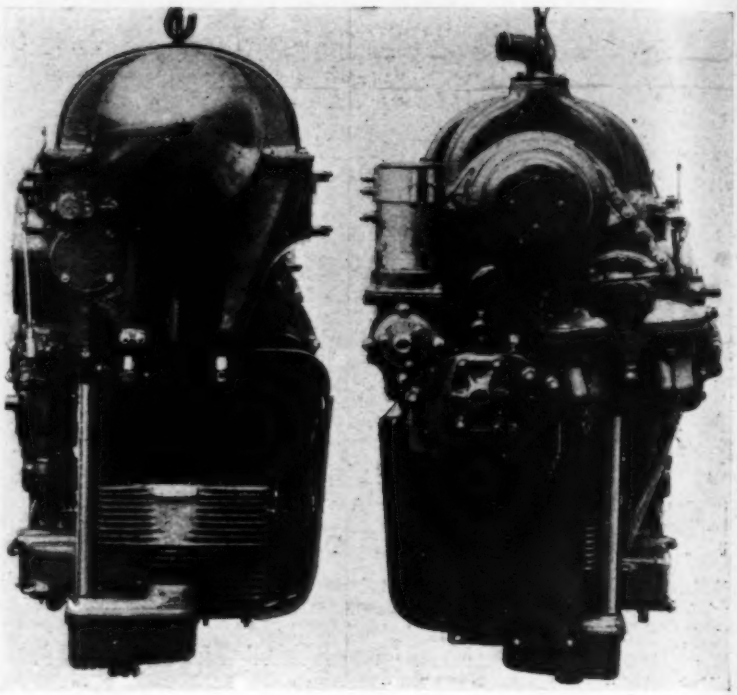
By 1928 further modifications were made, with the result that the Cirrus Mark III was introduced, developing 95 maximum b.h.p. for a total weight of 280 lb. These engines were used in many pioneering flights, such as Sqn. Ldr. Bert Hinkler's first solo journey to Australia, Lady Bailey's flight round South Africa, and Capt. Bentley's many return flights between London and the Cape.

In 1933 the company became known as the Cirrus-Hermes Engineering Co., and between that date and March, 1934, when Mr. Robert Blackburn became chairman, the company produced a whole series of Cirrus-Hermes from Mark I to Mark IV. Soon after, the works were transferred from Croydon to Brough, where new shops had been built and equipped with modern machinery and appliances for developing, constructing, and testing Cirrus engines. Recently the Cirrus-Hermes Engineering Co. was merged into Blackburn Aircraft, Ltd., and became the Engine Division of Blackburn Aircraft, Ltd.

A New Range

At Brough a new range of engines was started. The first was the 90 h.p. Cirrus Minor, which is already fitted in twenty-five types of aircraft, operating with marked success in fourteen countries. This engine has a capacity of 3,605 c.c. and produces a maximum b.h.p. of 90 at 2,600 r.p.m. It is a straightforward inverted, air-cooled, four-cylinder unit following closely on the lines of its elder brother, the Cirrus Major. Its weight, however, is only 227 lb., including a very complete specification.

The latest Cirrus Major, introduced in 1935 and modified twice since then, is fully described in the following pages. Its performance when introduced was high for its type—it developed 135 b.h.p. at 2,350 r.p.m. In its latest form this engine develops 150 b.h.p. at 2,450 r.p.m., a remarkable figure for an engine of this class.

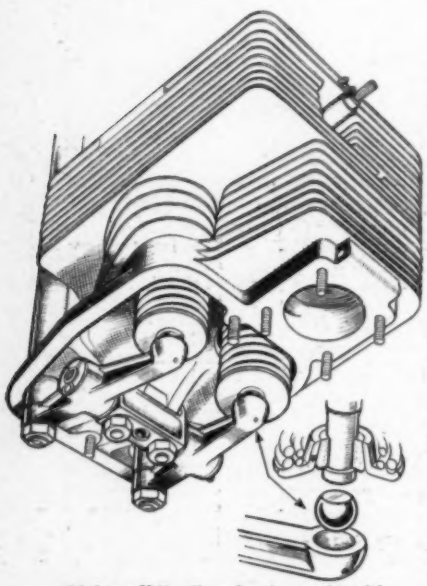


External cleanliness in design is a feature of the new Cirrus Major, two end views of which are shown above. On the left of the rear view can be seen the method of mounting the generator, while on the right are the twin fuel pumps and filters.

The Major is now in series production along with the Minor at Brough. It is being fitted to the Miles Magister as used by the R.A.F. for training purposes, in the Percival Gull, the Blackburn B.2, the G.A. Cygnet, and a number of foreign aircraft.

Among the recent developments which have taken place in the Engine Section are the appointments of Mr. C. S. Napier as research and development engineer, and Mr. E. Mitchell (formerly chief engineer of the De Havilland Aircraft Co.) to chief engineer of the Cirrus Engine Section. Mr. J. L. H. Bishop, formerly research engineer (materials) of the Bristol Aeroplane Co.'s engine department, has taken up his duties as chief designer to the Cirrus Division at Brough.

Such a strong combination augurs well for the future success of those two pioneering concerns—the Blackburn Aircraft Co. and the Cirrus Engine Division.



Light "Y" alloy heads, each with twelve studs and special steel valve seat inserts, are used in the Cirrus Major.

THE NEW CIRRUS MAJOR

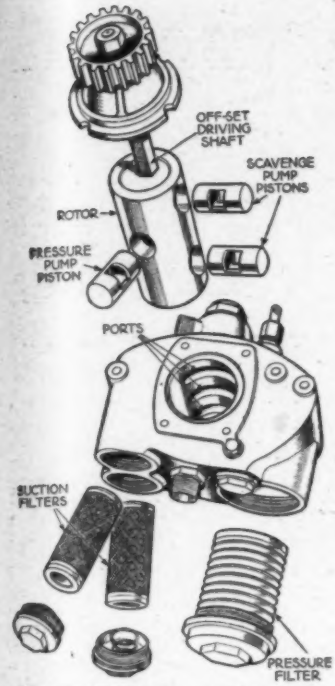
THE Cirrus Major is a development of the original Cirrus and Hermes engines. The Major made its first appearance in June, 1935. It was introduced as an inverted air-cooled four-in-line, developing the maximum of 135 b.h.p. at 2,350 r.p.m. Since then various modifications in the design, and the use of new materials, have brought about a vastly improved performance, while its exterior has been cleaned up to the extent that there are now no external oil leads, except the usual services from and to the tank. Likewise all controls have been reduced to a minimum.

Basically, the Cirrus Major 150 engine is an inverted air-cooled four-in-line, of simple but exceptionally robust design. It has a bore and stroke of 120mm. and 140mm. respectively, giving a capacity of 6,330 c.c.

Each of the four cylinders is retained to the crankcase by four long studs with ¼in. distance pieces, to allow a certain degree of elasticity. The cylinders are wholly machined throughout from normalised billets of "55" carbon steel. From the base the skirt tapers up to the first of 24 deep fins. The top flange is machined to fit into the spigoted "Y" alloy heads. The base of the cylinder is recessed into the crankcase to the extent of approximately 2¾in. A special oil-resisting rubber washer is used for the cylinder-to-crankcase base joint.

Each cylinder head is secured to the cylinder flange by means of twelve deeply set studs, a gastight seal being obtained by the use of a plain circular laminated copper gasket. The head is machined from a casting roughly rectangular in shape and incorporating the upper half of the rocker box casing. While the inlet port is radiused into a horizontal plane, the exhaust is radiused in the opposite direction towards the vertical, so that when the exhaust stubs are fitted they point in a downward direction.

Special valve seats are shrunk into the heads. A Monel seat is used in the case of the exhaust, while nickel-chrome high-expansibility steel is employed for the inlet. In both cases the seats have slightly tapering walls and are pressed into the head after the latter has been subjected to a temperature of 300 degrees C. for twenty minutes. The metal



Three small pistons, working in an eccentrically revolving rotor, are the main feature of the triple reciprocating oil pump.

round the seats is then peened over and any surplus turned off to the final depth.

A feature of the head, which is of the pent-roof variety, is that the two sparking plugs are of the bottom seating type. A bronze sleeve adaptor is threaded down into an orifice and abuts on a shoulder formed in the cylinder head so that when a plug is fitted it beds home on to the shoulder and not on to the adaptor.

Prior to assembly each head is carefully measured for capacity before being fettled to limits of plus or minus 2 c.c.

Both inlet and exhaust valves are machined from K.E. 965 steel. The exhaust valve differs from the inlet in that it has a 12 mm. stem, while the latter is approximately 2 mm. smaller. In contour the heads are tulip shaped, the shape being more marked in the case of the inlet. Neither face nor stem is subjected to special treatment. Both valves operate in phosphor-bronze guides, which differ only in that the inlet guide is slotted to release any pressure which might develop inside the rocker box through leakage from the exhaust. The valves are fitted with two concentric springs located by normal steel collets. They are operated by S. 11 nickel-chrome steel cup-ended rocker arms, the bearings of which are situated nearer to the push-rod socket than the valve. The rocker bears on the stem through a flatted ball recessed in a cup at its extremity. This principle is designed to obviate side thrust on the valve stem. The solid Dural push-rod, with steel ball ends, fits into an adjustable screw socket. This socket is threaded through the rocker and locked by a hexagon nut.

The rocker standard is a simple hollow rectangular forging in 3 per cent. case-hardening steel. The bearing pins at either end are ground to fine limits. These pins have a small groove at each end for a spring circlip to secure the rocker arm when fitted. The complete rocker gear is encased in a Dural cover which is filled with oil to a predetermined level prior to fitting. The cover and Klingerite washer are secured by a single knurled nut which is spring loaded and engages with a small stud recessed in the cover. The rocker gear of each cylinder relies for lubrication on the oil retained in its cover. It is not dependent on any other source of supply.

The new Cirrus Major is equipped with pistons designed at Brough but made by Specialloid, Ltd. The piston is of slipper type and is fitted with two Wellworthy gas rings and one scraper. The former are of the new tapered section type while the latter is fitted into a deep draining groove. To prevent oil building up in front of the scraper ring, the piston is fitted with an additional groove adequately drained by a series of small holes leading into the inner walls.

The fully floating gudgeon pin is machined out of 3 per cent. nickel case-hardening steel. It is secured by retaining washers and circlips at each end. Neither the piston bosses nor the small end of the connecting-rod is fitted with bushes.

Each connecting rod is a deep H-type Hiduminium alloy forging to B.S. Specification L. 40. White metal, backed with a steel shell, is used for the big-end bearings. The cap is secured to the connecting rod by means of two bolts. Drilled through the cap and bearing are two small oil holes which ensure lubrication of the pistons, etc.

The Crankshaft

The four-throw crankshaft is supplied complete in every detail by Laystall. It is forged from nickel-chrome vanadium steel to B.S. Specification S. 81. The shaft is drilled out and sealed by a number of conical discs which are recessed into the webs. Oil is fed into each of the five main bearings and thence into the shaft to the big-end bearings via leads drilled through the web of each throw.

At the back of the shaft a starter engagement pinion is fitted and pinned in place. A crankshaft pinion for the timing gear is then fitted over the end and, together with two oil slingers, is secured by a large nut and circlip.

To the forward end of the shaft is fitted a large-diameter, deep-groove ball thrust bearing. Die-cast main bearings are fitted up with deep-sectioned main bearing caps. The caps are secured to the crankcase webs or intermediate walls, a method which enables the cover to be removed without disturbing the bearings in any way.

Possibly the most interesting component of the Cirrus Major is the crankcase unit, which is cast in R.R. 50 Hiduminium. It has three deep webs or intermediate walls so arranged that each throw of the crankshaft virtually revolves in its own compartment. The intermediate walls have a series of deep-sectioned fillets into which the two cylinder base studs on each side of the walls are threaded. These fillets are situated so that the thrust of the cylinder head studs is taken to the centre line of the main bearings, the studs of which are also threaded into similar fillets.

SPECIFICATION

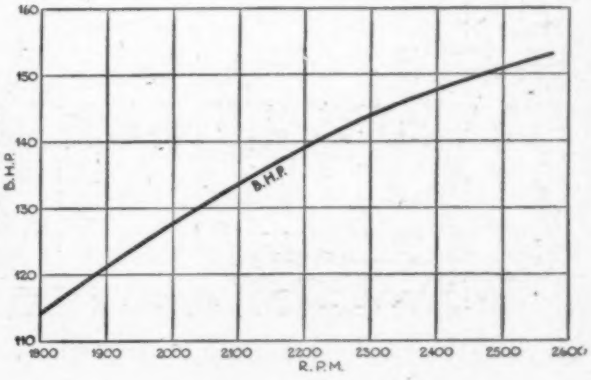
Bore	120 mm.
Stroke	140 mm.
Capacity	6,330 c.c.
Compression ratio ..	5.8 to 1
Normal B.H.P. at 2,200 r.p.m. ...	138
Maximum B.H.P. at 2,450 r.p.m. ...	150
Rotation	Left-hand tractor, direct drive
Cruising r.p.m. ...	2,150–2,200
Fuel consumption ...	6.5–7 gal./hr. at 2,200 r.p.m.
	11 gal./hr. at 2,450 r.p.m.
Oil consumption ...	1–2 pt./hr.
Oil pressure	30/40 lb./sq. in.
Weight complete, less generator and starter	325 lb.

Each bearer foot facing is backed on the inside walls of the crankcase by deep-sectioned webs. The main oil delivery gallery is cast with the case and is situated to starboard, slightly above the five-bearing camshaft. Oil is delivered from the main pump at the back of the engine through this gallery to accommodation holes suitably drilled in the intermediate and end walls of the crankcase to the main bearings. A smaller-diameter oil gallery leads through the walls on the near side to enable oil accumulating in wells at the forward end of the engine to be scavenged.

Before the main bearings are fitted a hollow-shouldered dowel is inserted into the oil-hole of each bearing seat. This serves to locate the bearing and obviates any risk of it turning and causing an oil stoppage.

The crankcase cover, which has three transverse webs coinciding with the three centre main bearings, is secured by sixteen bolts on each side. At the forward end a special circular casing is bolted to both the crankcase and its cover. This casing fits into an oil slinger attached to the crankshaft and, together with the scrolling on its inner face, successfully prevents the egress of oil. The crankcase cover is fitted with lifting eyes attached on the centre line front and rear.

The crankshaft pinion engages not



Straightness of the power curve of the Cirrus Major 150 is but one of many salient points of this engine.

only with the camshaft pinion, but also with an idler gear which in turn drives the oil pump and one magneto. The other magneto is driven by the camshaft pinion.

The camshaft is equipped with four large-diameter bearings. It is machined from carbon case-hardening steel to B.S. Specification S.14. Each bearing surface is scrolled and runs in bushes housed in the crankcase. A fifth bearing is situated in the rear wall of the crankcase. This bearing—a plain bronze one—has an external annular groove which registers with a small pocket or well in the crankcase; oil accumulates in the groove and ensures lubrication of the bearing. The camshaft pinion is keyed on to the end of the shaft, which, incidentally, is hollow and equipped with a keyed plug fitted into the end to supply the drive for the petrol pump.

Of simple design, the vertically mounted, case-hardened tappets bear on the cams. The slipper-type tappets are housed in detachable Dural guides which fit into the raised bosses cast integral with the crankcase. The push-rods are encased in tubes, the lower ends of which fit into special oil-resisting rubber-lined recesses while the other ends are located by sliding a section of rubber tubing over each tappet guide. The rubber is retained by means of belled-out ridges on the push-rod tubes.

Accessory Details

The short shaft driving each spigot-type magneto is carried in two journal bearings together with a plain scrolled Dural bearing housed in a bolted-up casing. Provision is made for a tachometer drive and generator.

Following normal Cirrus practice, the timing cover can be removed without disturbing the gears. Attached to the cover is the special triple reciprocating oil pump unit, together with the combined Amal petrol pump and filters.

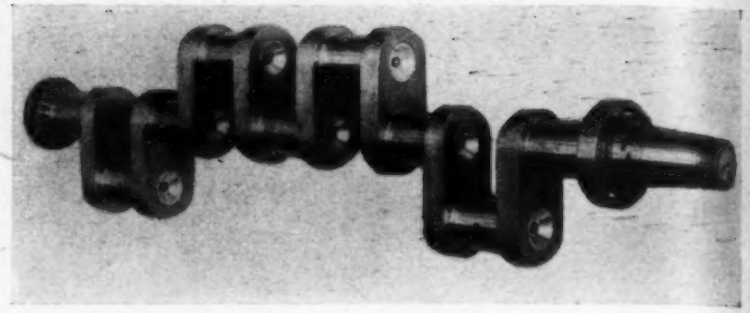
The oil pump is of an unusual design and incorporates an eccentrically mounted Dural rotor. Inside three chambers drilled transversely across the axis of the rotor are three pistons which are located on a squared shaft which forms the axis of the rotor. The pistons are free to slide across the axial shaft and bear against the walls of the cylinders formed in the rotor. Owing to the eccentric motion of the rotor the pistons travel up and down their respective bores which register with ports cut in the walls of the rotor casing.

The pump delivers oil at the rate of one gallon every 22 seconds. The two outside pumps are for scavenging the oil, which is delivered back to the oil tank through two simple barrel-type gauge filters. The delivery pump is equipped with a special filter having a series of hollow gauze discs tapering towards their circumference. These discs are mounted on a tube with holes drilled to coincide with each disc; oil flows through this tube and out via the discs. A simple pressure release valve is incorporated. Incidentally, one scavenging pump is attached to a small oil gallery which passes through the intermediate walls of the crankcase to the forward end of the engine, its object being primarily to cope with excess oil accumulating during the course of a dive. All three filters can be withdrawn *in situ* from beneath.

When specified, a B.T.-H. inertia starter is bolted to the timing case; one bolt, however, passes through to the crankcase wall in order to cope with the thrust of the starter when it is engaged. The starter, incidentally, was originally developed by the Cirrus Engine Department at Brough. The two Simms magnetos, mounted one on each side of the crankcase, incorporate automatic advance and retard mechanism.

Petrol is supplied to the Type A.1 48G Claudel-Hobson carburetter, by means of an Amal twin pump with twin filters which is mounted on the timing case cover and driven by a keyed tongue engaging with the camshaft.

The carburetter, which has an independent altitude control, is equipped with a special Amal flame trap, the shape of which enables use to be made of the warm air inside the engine cowling. The down-draught carburetter is attached to a single light alloy induction manifold casting which is secured by two accessible bolts to each inlet port and is provided with a suction elbow for vacuum controls. By simply loosening the steady attached to the flame trap, withdrawing the eight manifold bolts and disconnecting the petrol pipe and two control connections, the whole induction system can be withdrawn as a unit.

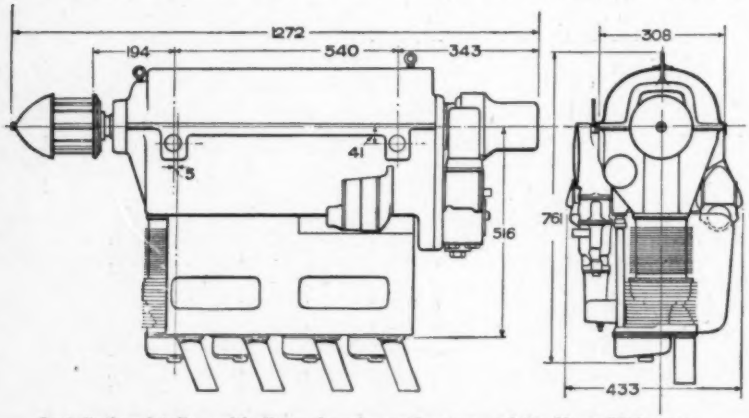


The four-throw crankshaft is fitted with a deep groove journal thrust race at its forward end.

All Cirrus Major engines are supplied complete with the induction system already described, together with twin magnetos, eight sparking plugs, airscrew boss and spinner, resilient bearer feet, cylinder cooling chute and baffles, exhaust stubs and a tool-kit for running adjustments. The finish of the engine is olive green with stove-enamelled cylinder fins. Other external parts are either cadmium plated or stove enamelled. The B.T.-H. inertia starter, together with the B.T.-H. C. 3,000 60-watt 12-14-volt generator, are fitted when specified.

Maintenance instructions advise that after the engine has been run in service for fifty hours the oil should be changed, petrol and oil filters, jets and sparking plugs should be cleaned, and the magneto and valve clearances be checked. The engine should be given a top overhaul after 300 hours, and at 600 hours it will be due for a complete overhaul.

It is obvious that great care and attention has been paid to accessibility, and the absence of extraneous fittings makes the engine one of the cleanest designs we have seen. It is obvious that the ground engineer's task has been considerably simplified by careful design.



Installation details—with dimensions in centimetres—of the Cirrus Major 150.

CONTRIBUTORS TO THE CONSTRUCTION OF THE CIRRUS.

Accles and Pollock, Ltd., tubing; Amal, Ltd., fuel pumps, flame trap elements; Albion Drop Forgings Co., Ltd., gear stampings; Birmingham Aluminium Casting Co., Ltd., aluminium and Elektron castings; W. T. Clarke and Co., Ltd., spinner; Dermatine Co., Ltd., oil-resisting joints; E. M. V. Engineering Co., Ltd., machined gears; Fletcher Bros., steel pressings; Glacier Metal Co., Ltd., con-rod and main bearings; Hall and Hall, Ltd., joints; High-Duty Alloys, Ltd., connecting-rod stampings; Hughes Johnson Stampings, Ltd., stampings; H. M. Hobson, Ltd., carburettors; Hoffmann Manufacturing Co., Ltd., ball bearings.

Richard Klinger, Ltd., joints; K.L.G. Sparking Plugs, Ltd., plugs; Laystall Eng. Co., Ltd., crankshafts; Light Production Co., Ltd., pistons; Wm. Mills, Ltd., aluminium castings; Motor Components, Ltd., valves; Manganese Bronze and Brass Co., extruded bronze; Phosphor Bronze Co., Ltd., valve guides and bronze castings; J. Richards and Sons, Ltd., induction pipes and cowling.

J. Stone and Co., Ltd., valve-guide castings; Specialloid, Ltd., pistons; Sterling Metals, Ltd., Elektron castings; Smith's Stamping Works, Ltd., stampings; Geo. Salter and Co., Ltd., all springs; Simms Motor Units, Ltd., magnetos and couplings; Joseph Sankey and Sons., Ltd., steel pressings; Geo. Turton Platts and Co., Ltd., cylinder billets; Weyburn Eng. Co., Ltd., camshafts and tappets; Wellworthy Piston Rings, Ltd., piston rings; Chas. Weston and Co., Ltd., oil seals; James Walker and Co., Ltd., joints; Henry Wiggin and Co., Ltd., Monel metal; Northern Rubber Co., Ltd., rubber mouldings.

COMMERCIAL AVIATION

FRENCH NIGHT MAIL: The first of the Air Bleu night mail services was run on May 10, when a Caudron Goeland left Paris for Bordeaux and Pau. The machine is seen here on the tarmac at Le Bourget.

THE WEEK AT CROYDON

Cabotage Again—and Kindred Difficulties : Pigeon Conscription : Reversing the Rule : "A. Viator's" Transport Commentary

TO take this cabotage business a step further than I did in my notes last week, here is an example of it. A very important municipality in England will shortly open its new airport and Royalty will be present. The municipal authorities and the display organiser for the opening ceremony urge foreign visitors to bring air liners to contribute to the success of the proceedings. Foreign air line owners are wanted there because it is hoped to get them to operate lines between the airport and the Continent. The authorities wish to show them what an excellent and well-equipped airport now exists.

It is, or would be, a combination of business and pleasure on both sides if the foreign air line companies were allowed to attend. Naturally, the air line would like to pay its way by booking a number of paying passengers and probably could do so.

As things are at present it is next to impossible for the foreign air line to obtain permission to attend. Taking it by and large, it is the municipality which loses most. Imagine the opening of a new sea harbour, designed to cater for shipping of all nations, and then consider the feelings of the harbour authorities if a bunch of official obstructionists refused to allow foreign ships to enter the harbour on the official opening day.

The other day, Capt. O. P. Jones, of Imperial Airways, had a special charter trip to Cherbourg in order to bring back four American travellers from the *Queen Mary*. They had urgent business in London and could not afford to waste time coming on slowly to Southampton in the ship. They came to Croydon in a D.H. 86, therefore, and saved a very great deal of valuable time. Presumably the whole thing was arranged by radio from the *Queen Mary* and it is interesting to note that if a French company had wanted to do an identical job from a British port there would have been all sorts of difficulties in the way—if, for example, the aerodrome adjacent to the port did not happen to have Customs facilities.

There is another highly unreasonable Customs ruling which has come into being within the last few years. Companies such as Air France, K.L.M. and D.L.H. have been flatly refused permission to demonstrate to travel agents, the Press and important travellers in England any new type of commercial aeroplane which they may consider placing on the line to London.

One foreign company, to my knowledge, has protested to Customs and has stated officially that reciprocal facilities would be granted to a British air company on that nation's chief airport. One of these days it will be deemed commercially expedient by a British firm running a service to that particular country to show its aircraft to the travel agents and Press and then there will be some fun. Although the foreign company I speak of has assured Customs that only persons directly interested in travel would be invited to make flights and see the machine, permission has been consistently refused on the absurd grounds that the demonstration may be used to sell air liners.

That carefree bird the carrier pigeon has always been rough but honest. Now he will have to take a lofty (pardon) attitude and wear a black hat and little striped pants. The poor bird has been conscripted, or conscribed, and even perhaps circumscribed, for he has joined the Air Ministry. The pigeons' owners, according to the regulations, "must give an undertaking to place the services of their birds at the disposal of the Service department when necessary."

Ornithology

The immediate reaction of one prominent fancier to this somewhat feudal attitude was to resign from the whole show on the grounds that the Service department could blinking well find their own glamour girls. The regulation which says "members will be asked to assist . . . in the supply of birds for Air Force service" is fairer. Provided someone pays for my dinner at the London Casino, for example, I'm always ready to assist in a little matter of that sort.

We confidently expect (although you never know, do you?) the first two repowered Ensigns at Croydon within a week or two and after that, all in good time, the other four. They should be in order this time, because I understand that senior Imperial Airways captains have tested them.

There are rumours that the present Airport Hotel is to be taken over by the Air Ministry to relieve that lack of office and other accommodation about which I protested in this column so many years ago. If so, the idea seems to be to build a new hotel at the bottom of Purley Way.

The great thing is to be original, of course, and to do the opposite. Poor mutts on the Continent think it necessary for an Airport Hotel to be right on the flying field and for its restaurants and public rooms to give a view of the numerous and interesting activities of the place. How wrong they are, evidently.

A. VIATOR.

FOR EXPORT AIRLINES? The new Consolidated Model 31 boat which is described on page 531. Its lines are somewhat unusual and give an impression of compactness and small size which is belied by the figure seen near the nose. Judging from the fact that no appreciable window area is to be seen, this prototype has been built either for mail carrying or purely record-making purposes. The engines are 2,000 h.p. Wright two-row radials—seen in a machine for the first time.

Commercial Crossing

ON Saturday, May 20, the Boeing 314, *Yankee Clipper*, left Port Washington at 18.07 p.m. (B.S.T.) on the first commercial crossing of the Atlantic for Pan-American Airways. The machine carried nearly 200,000 letters, as well as a certain amount of minor freight, and the crew numbered twelve, with Capt. La Porte in charge. The latter, it may be remembered, came over with Capt. Gray on the survey crossing last month. Two Pan-American "observers" were also on board.

The 314 reached Horta, in the Azores, at 07.25 (B.S.T.) and stayed there for a little over three hours before leaving for Lisbon, which was reached at 20.49 (B.S.T.). The 3,800 miles had been flown in about 23½ hr., at an average speed of 162 m.p.h. Lisbon was left at about 07.00 last Monday for Marseilles, and by now the machine should have left Southampton again on the return journey.

According to the terms of the C.A.A. licence to the company, five two-way mail flights must be made before passengers are taken, and it is hoped that these will be completed by the end of June. The actual mail destination of each will alternate between Marseilles and Southampton, and it is planned to complete one flight every week.

So far as our own plans are concerned, there now seems to be some doubt whether the British mail service will be started this year. Trials will have to be made with the refuelling system, and by the time these have been completed Newfoundland will have become difficult because of ice. Nor are the Short "G" class boats likely to have completed their tests before the end of the summer.

More Merger Arrangements

FOR some time considerable reorganisation has been going on in various departments of Imperial Airways in preparation for the merger. Last week two new appointments were announced, following that of Mr. A. C. Campbell-Orde, who came over from British Airways to take control of the operations department.

This department is virtually new and was established to co-ordinate the work of a number of different sections of the company which formerly dealt with the questions of maintenance and service improvement. Air Comdre. A. Fletcher has been appointed as Ground Services Officer and will be in charge of the construction, equipment and maintenance of Imperial stations on both European and Empire routes. Sqn. Ldr. E. F. Turner, formerly the radio superintendent, has now been appointed Communications Officer and is in charge of all wireless equipment and communications, as well as of meteorological services.

Air Comdre. Fletcher was the first director of Air Quartermasters Service in 1918 and he later became Deputy Director of Organisation before joining Imperial Airways in 1930. Between 1915 and 1935 Sqn. Ldr. Turner was a signal officer in the R.F.C. and R.A.F., and he joined Imperial Airways in 1936.

By this readjustment of duties in the revised operations department Major H. G. Brackley, who was formerly Air Superintendent, has been relieved of certain of his internal responsibilities, and will be free to carry out special work in connection with the survey of new routes—which has formed the greater part of his work since he was appointed in 1924, on the formation of Imperial Airways.

Yet Again

IN charge of M. Guillaumet, with a crew of seven, and carrying the Assistant Director of Civil Aviation, the old Latécoère *Lieutenant de Vaisseau Paris* has made another east to west crossing of the Atlantic. The thirty-seven-ton boat left Bordeaux on May 16 for the Azores and reached Port Washington, New York, on May 19. Two members of the crew, the radio operator and navigating officer, have each, curiously enough, made exactly 100 crossings of the South Atlantic.

Night-lighting at Portsmouth

THE Airport Committee of the Portsmouth Corporation has now decided to provide full night-landing equipment at the aerodrome. At the same time it is reported that the landing area will be considerably extended, though this is already more than satisfactory in comparison with other municipal airports. At least part of the reason for the modifications is that Portsmouth is to be a Volunteer Reserve training centre.

Imperial at the World's Fair

THREE films, one of them in colour, showing Imperial Airways' activities, will be shown at the World's Fair in New York. One of these—"Wings over an Empire"—has just been specially selected for showing in the British Pavilion.

Flight Planning

A RECENT *Notice to Airmen*—actually No. 138—brings the much-needed flight-planning system a little nearer. In this *Notice* it is impressed that the radio and control services are provided to assist navigation, to effect bad weather approaches, and to avoid the possibility of collisions. In order to reduce the volume of radio traffic pilots are requested, when possible, to consult the airport control officer before departure, so that information about other machines and about the most suitable height and/or track may be agreed upon. Thereafter it is essential that the machine should not deviate from the agreed flight plan.

Faster to Oslo

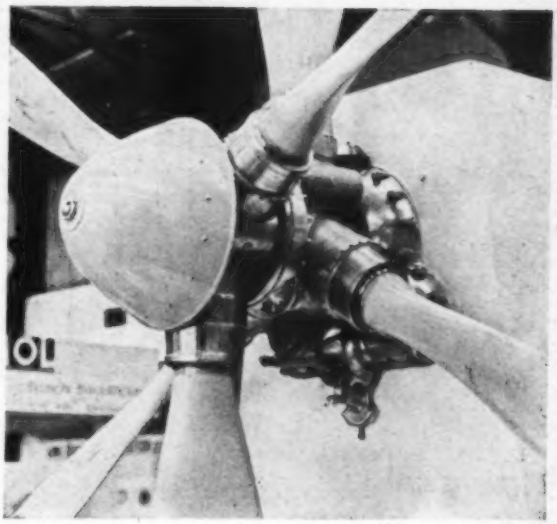
NOW that the new Oslo land airport is ready for use, D.N.L., working in pool with K.L.M., will start, on June 1, a service between Oslo, Christiansand, Amsterdam and London. The route will be covered once daily in each direction, and the journey time will be approximately 5½ hr., including a somewhat prolonged sea crossing between the southernmost corner of Norway and Holland. For the moment D.N.L. are, we learn, chartering a K.L.M. Douglas D.C.3 for their part in the service.

Incidentally, K.L.M. are expecting the first of their four D.C.5s during the autumn, the other three to follow at short intervals. These medium-sized transports will be used mainly on the internal services, and possibly on the shorter European routes, such as those between Amsterdam and London and between Amsterdam, Manchester and Liverpool.

AT the R.Ae.S "STATIC" SHOW

Equipment on view at the Garden Party.

Last week we described the flying display and aircraft at the Royal Aeronautical Society's Garden Party; in these pages we review the show of equipment held on the same occasion.



The Fairey "contra" air-screw, consisting of two three-bladed, fully feathering, constant-speed air-screws revolving in opposite directions.

"Flight" photographs.

AIRCRAFT COMPONENTS, LTD.—One of the largest exhibits in the Display was undoubtedly the working retractable Dowty undercarriage, designed, it was stated, for a medium bomber. Throughout the afternoon visitors were able to see for themselves the speed and slickness of the operating mechanism. The undercarriage demonstrated incorporated the new Dowty suspension unit with shock absorbers on either side of the wheel. The hydraulic mechanism incorporates an automatic relief valve which allows the power pump to idle except when the undercarriage is being operated.

AIRCRAFT OPERATING CO., LTD.—An air survey exhibit can be incredibly dull or extremely interesting, according to the way in which it is presented. This display, illustrated with some scores of photographs, was

Personalities snapped at the show: Sqn. Ldr. M. E. A. Wright of the Fairey Company and Mr. A. H. R. Fedden, the new president of the R.Ae.S.

very definitely in the latter category. Half the exhibit dealt with the revision of 1/2,500-scale Ordnance maps and the other with the wider applications of aerial photography. A nicely made model showed very clearly how an overlapping mosaic is made, and a stereoscope, showing in relief an aerial view of a suburban area, proved an irresistible attraction to visitors.

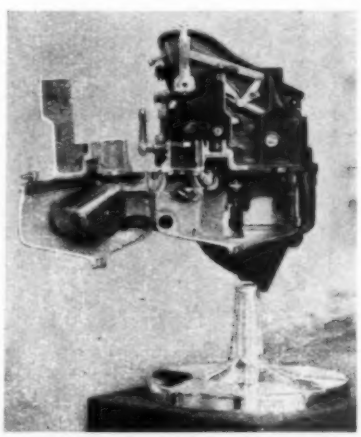
ALVIS.—Complete with the hub of a De Havilland constant-speed airscrew, the Alvis Leonides looked very pretty indeed. It has a capacity of 11.78 litres and the international rating is 415/435 h.p. at 3,000 r.p.m. and 8,250ft. On the back of the engine is an easily detachable accessory drive gear box which can be supplied in varied designs to suit any range of accessories.

ARMSTRONG-SIDDELEY.—The new Cheetah XI seven-cylinder radial which made its début at Paris last year was the key exhibit on the Armstrong-Siddeley stand. This pleasing little unit is now giving no less than 460 h.p., which is very creditable for an engine of such small diameter. In company with the Cheetah XI was a sectioned two-speed blower as used on the Tiger VIII.

AUTOMOTIVE PRODUCTS, LTD.—A number of different types of Lockheed hydraulically and pneumatically operated equipment were to be seen. In the hydraulic section various types of undercarriage, flap and bomb door jacks were shown, together with engine-driven pumps, and selector and flow control valves. On the "Airdraulic" side were undercarriage and tail-wheel shock-absorber struts, with an example of the latest type of axial roller bearing. Avery wheels and brakes were also shown.

AVIMO, LTD., showed the visitor a wide and instructive selection of their aeronautical accessories. These included a beautifully sectioned carburetter, showing the method of controlling a single isocorrective needle in relation to both boost pressure and altitude; a new and simple remote control, consisting of a drilled flexible strip, sprocket-operated and sliding in a flat strip-steel channel; a new inertia starter, embodying an ingenious elastic unit for conserving the energy normally lost in the clutch mechanisms of starters of this type; some simple flexible pipe couplings in a great variety of sizes; an unspillable battery; electrically heated pressure heads; electrical junction boxes; and a finely made tail drift sight—similar to the one which attracted a deal of attention at the Paris show—embodying a chronometric device by which ground speed can be measured.

BENDIX, LTD.—A number of interesting brake components and accessories were shown on this stand. A complete set of sectioned pneumatic brakes and operating gear, as used on the De Havilland Albatross, formed the basis of the display. The Two-Leading-Shoe hydraulically operated brakes were there, with examples of the Bendix mechanical differential control unit and a range of Tracta Constant-Velocity joints. One of the most interesting features on this stand was a working example of a new system evolved by the Bendix people to enable the instructor to release his pupil's brakes and assume control himself.



A finely sectioned Avimo carburetter.

BRISTOL.—From many points of view the two-row fourteen-cylinder sleeve-valve Taurus (standard power plant of the new Beaufort general reconnaissance torpedo-bomber monoplane) is the most remarkable engine the Bristol company has ever turned out, giving an output of 1,075 h.p. and measuring only 46½in. in diameter. We look forward to seeing a pair of "Tauri" in a fighter and two or four of the larger Hercules units in a big bomber or flying boat. Shown in company with the admirable sectioned Pegasus, examples of these sleeve-valve units impress particularly by their clean design.

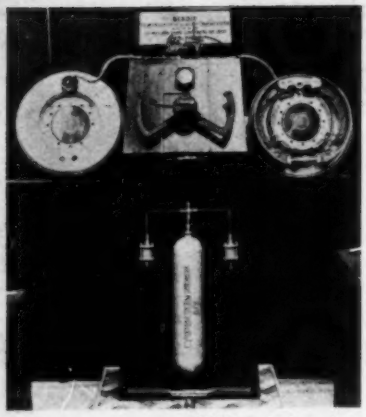
BRITISH CELANESE, LTD. — "Novellon" transparent cellulose acetate sheeting was shown by British Celanese, Ltd., in the form of complete cabin hoods, windscreens, cupolas, arc welded, cut, drilled and riveted specimens. The material has considerable mechanical strength, and the moulded specimens showed surprisingly little distortion of view.

CIRRUS.—During development tests the 90-h.p. Cirrus Minor (shown in company with the 150-h.p. Cirrus Major) satisfactorily completed over 400 hours' running at maximum permissible r.p.m. following long periods at varying speeds. Both the Minor and the Major, as shown, are finding wide application, their success in the export market being particularly gratifying.

DART AIRCRAFT, LTD., showed examples of their types of construction in the form of an uncompleted rudder. There were also models of the different types of Dart aircraft, and photographs of historical aeroplanes.

DE HAVILLAND.—Looking very sophisticated in their red and black finish the diminutive 90-h.p. Gipsy Minor four-cylinder unit and the twelve-cylinder inverted-vee Gipsy Twelve (or Gipsyking as the Air Ministry call it) were among the most attractive of the exhibits. De Havillands also presented a 5,000-size Hydromatic airscrew for engines of up to 1,500 h.p. and a constant-speed airscrew of 1,000-size.

DUNLOP RUBBER CO., LTD.—The purpose of this display was to show visitors the various applications possible with the Dunlop hydraulic system. The stand was fitted with a joystick lever and button, which controlled the operation of a dummy Hispano shell-gun and two Brownings. Cocking of the former was controlled by a hand-operated valve, which automatically tripped at the conclusion of the operation. The gun and the two Brownings were fired by pressure on the button. The system is designed with a safety valve in the hydraulic circuit of the undercarriage system to ensure



"Flight" photographs.

Bendix pneumatic braking equipment as fitted to the D.H. Albatross.

that the guns can only be fired when the latter is retracted.

DURASTEEL ROOFS, LTD.—Interest in the display of this company centred around a special composite fire- and splinter-proof door designed for protection against the blast of a 500-lb. bomb at 50ft. The door is composed of fire-protection panelling, special impact-absorbing sheeting and Manganese-chrome steel, the whole being bound with cold rolled steel channel sections. The door is fitted with a Pilkington armoured-glass observation port, 2in. thick and 1¼in. in diameter.

ELLISON INSULATIONS, LTD.—The purpose of this display was to show visitors the many and varied applications of Tufnol, which is a highly developed laminated plastic with a weight approximately half that of aluminium and possessing a tensile strength ranging from 3½ to 7½ tons per sq. in. It can be used for electrical insulation, gear pinions, control blocks, etc., and can be machined without special equipment. An interesting feature was a large streamlined pressing, designed to fit over the aerial used in connection with the Lorenz system.

FAIREY AVIATION CO., LTD.—On this stand by far the most interesting exhibit was the new contra airscrew combination of two three-bladers running in opposite directions. This airscrew is of the fully feathering constant-speed type and is, in addition, provided with a pre-selector arrangement whereby any desired pitch angle may be reached by merely pressing a button. The double airscrew is surprisingly neat in external appearance, and we are told that it is comparatively light, owing to the fact that it has been stressed by the German method. This is possible because of the constant-speed feature, which prevents over-revving in a dive.

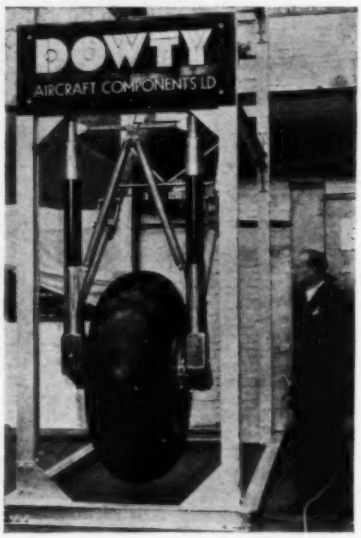
GALLAY, LTD.—Quite one of the most attractive displays was to be seen on this stand. Drawings were shown of the new Gallay aerodynamic cooling system, together with the technical data connected with it. A combined dual-stage oil cooler, with hot-pot and oil reservoir to ensure rapid warming-up for take-off, was shown with a combined ethylene-glycol radiator and oil cooler. Various systems for air conditioning and heating were portrayed.

HIGH DUTY ALLOYS, LTD., showed examples of Hiduminium high-tensile aluminium alloys in cast and wrought form; macro-sections of pressings and stampings; photographs of testing apparatus and examples of the results obtained from research into X-ray crystallography gave an excellent idea of the care taken in the Slough works.

H. M. HOBSON (AIRCRAFT AND MOTOR) COMPONENTS, LTD.—It is safe to say that but for the fact that it is now possible to relieve the pilot of most of the details of engine control, the good results now being obtained in the matter of fuel economy would be impossible. The master control carburetter shown by H. M. Hobson combines carburettor, three-stage variable datum boost control, and two-stage automatic mixture control for altitude. This combination also forms a safety device which prevents the pilot from damaging his engine by accidentally giving it excessive boost.

JABLO PROPELLERS, LTD., exhibited blades in reinforced wood for variable-pitch airscrews. The blades were shown in various stages of completion, and there were samples of compressed laminated wood planks. The blades were finished by the Jablo protective covering.

KELVIN, BOTTOMLEY AND BAIRD.—Although not seen in this country for the first time, the Kollsman Direction Indicator, seen in the Kelvin, Bottomley and Baird exhibit, was probably new to most of the Heathrow visitors. This is a vertical-type compass with a direct-reading needle and movable reference lines. The compass proper is at the base of the instrument, and



An impressive working exhibit: the Dowty undercarriage legs and wheel of "medium bomber" size.

the indicating needle is operated through a simple bevel gear from a "follow-up" needle. Also shown was the new K.B.B.-Kollsman sensitive electric r.p.m. indicator. In this, a small generator, driven by the engine, provides the power for a synchronous motor, which, in turn, gives the indicator reading. Magnetic drag is used to measure the speed of the motor, and it is possible for two motors—for instruments in different parts of the machine—to be operated by one generator. Sensitivity is the special feature of this new tachometer.

MAGNESIUM ELEKTRON, LTD.—To what great extent Elektron magnesium alloys are coming to be used in aircraft construction was well illustrated on the stand of Magnesium Elektron, Ltd., by numerous forgings and castings. These included forged and cast crankcases and aircraft wheels; a forged engine bearer; and a forged magnesium airscrew blade, produced by the latest methods giving high mechanical properties.

MINIMAX, LTD.—This firm, whose factory is situated not far from Fairey's Aerodrome, showed a range of fire extinguishers, including soda acid types for ordinary fires; foam types for burning liquids; and CO_2 extinguishers for petrol and electrical fires. Crash equipment was also shown.

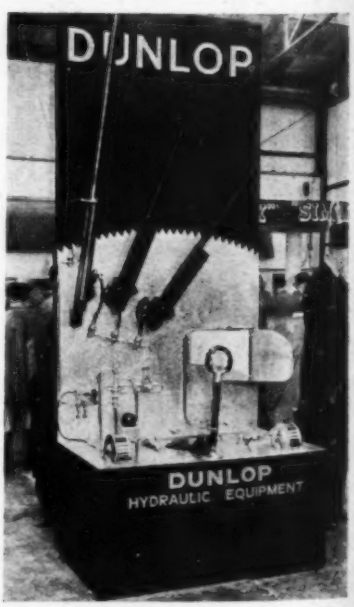
NAPIER.—Someone described the Napier-Halford Dagger VIII as "a solid slab of power," and that is just the impression it gives with its twenty-four tiny cylinders and its generally compact layout. One of these remarkable units was on show and caused one to anticipate with pleasure the appearance of the production type Hereford Bomber which will be the first modern monoplane to take advantage of the Dagger's peculiar qualities. Napier's show included a model of an air compressor and a cabin air-heater and storage tank by Robertson Coolers, Ltd.

NATIONAL FIRE PROTECTION CO., LTD.—Of outstanding interest to the aircraft operator was the Essex automatic fire-extinguishing unit for aircraft installation; it comes into action either by crash impact or by flame, or, alternatively, it can be actuated by hand. A wide range of transportable and portable apparatus, utilising methyl bromide, carbon tetrachloride and foam, were also shown, while a completely new item was a vapour detector which gives audible warning of the presence of petrol vapour.

THE PALMER TYRE, LTD., showed a 1120 × 380 mm. aircraft tyre and wheel, together with a sample of the materials used in tyre manufacture; these included a reel of the flattened, impregnated cord which forms the fabric of the tyre, and a chunk of the "raw" rubber used for treading. Other exhibits included hydraulic gun-control gear.

PLESSEY.—Suitable equipment for blind-approach training was the major item of interest on the Plessey-Breeze stand. With this, which is presumably designed for use in conjunction with a Link Trainer, both aural and visual indications are given in the usual way, the instructor controlling the signals of the main beacon, and of both the inner and outer market beacons, by means of push buttons. The visual dial carries the two marker beacon lights and a directional needle. A new type of Coffman pressure starter, which has the advantages of the old cartridge type of starter and none of its disadvantages, was also shown, with Pesco vacuum and fuel pumps. Somewhat out of sight below was an interesting gridded chart drawn to a gnomonic projection centred at 53 deg. W. long. In this projection great-circle courses are shown in straight lines over the area concerned, and it is of particular interest for D/F and "homing" purposes.

ROLLS-ROYCE.—The Merlin III as shown at Heathrow is almost identical with the Merlin II, but can accommodate more accessories and a De Havilland or Rotol constant speed airscrew. This model is going into the newer batches of Hurricanes, Spitfires, Battles and Henleys. Normal rating on



Dunlop hydraulic equipment, with its joystick control, for shell-gun and two machine guns.

NAVAL NOVELTIES : A fine formation impression of some of the new Blackburn Skua two-seater fleet-fighter dive-bombers (Bristol Perseus engine) from H.M.S. *Ark Royal*. These machines are the first monoplanes to be used as standard equipment in the Fleet Air Arm and are the latest of a long line of Blackburn products to see service with the Fleet.

At the R.Ae.S. "Static" Show

(*Continued.*)

87-octane fuel is 990 h.p., and 1,035 h.p. is available for five minutes.

ROTAX.—The principal Rotax exhibit stand was a section of leading edge fitted with the Goodrich pneumatic pulsating de-icing overshoe, together with an air pump and an electrically operated distributor valve through which the necessary periodic inflation and deflation is obtained. This de-icing equipment is being manufactured here by the British Tyre and Rubber Company, and by Rotax, who, of course, make the incidental items. On the same stand was a cut-down airscrew, with its spinner, on which fluid de-icing leads had been arranged. Ethylene glycol is fed through the leads, and hence down the leading edges of the blades by centrifugal action from a slinger ring. With the de-icer equipment were various examples of starter motors, magnetos and air pumps.

SHELL-MEX AND B.P., LTD.—Many of the outstanding features of the "See How They Fly" exhibition recently held at Shell-Mex House were brought out of their temporary retirement for the Garden Party. The modernistic panels and models provided a delightful Continental touch to the static display. The standard-type cockpit, the controls of which operated a small model aeroplane in a wind tunnel, was the chief attraction for the coming generation.

SIMPLIFIX COUPLINGS, LTD.—Many different types of Simplifix Patent Compression joints, made in a variety of materials, were to be seen here. The important feature of the Simplifix joint is that it can be broken and remade without damage. A metal-to-metal joint is obtained by screwing a nut down over an anti-friction collar and sealing ferrule.

SPERRY.—The most important exhibit on the Sperry stand was not, in fact, given very particular prominence, and may even have been missed by many of the visitors. This was a true gyro-compass, in which the normal directional gyro drum is basically controlled by a magnetic compass needle. By means of two air jets which are controlled by the compass movements, the directional gyro turns always to the magnetic course, while being otherwise operated gyroscopically, so that northerly turning and acceleration errors are not included in the indications. After a turn has been made, during which the gyro operates in the ordinary way, the compass settles the drum down at its correct position.

The full operation of the Sperry automatic pilot was specially demonstrated. Other items were sectioned examples of the directional gyro and artificial horizon, with a set of Lord anti-vibration mountings.

Palmer aircraft wheel and tyre, with section of cord fabric.

TECALEMIT, LTD.—This firm are experts in equipment for handling liquids, or for making liquids do useful work. Thus, they exhibited the Tecalemeter positive displacement meters for accurate measurement up to 2,200 g.p.m.; air and water eliminators; engine oil cleaners; their safety refuelling nozzle with self-operating cut-off device; the "Aerodrain" for draining tanks and sumps; and a hydraulic pump and motor for the operation of aircraft hydraulic equipment.

VICKERS-ARMSTRONGS. — Strictly correct models of the Spitfire, long-range Wellesley, and Wellington appeared in dignified solitude. Both the Wellington and Spitfire could be examined "full scale" on the aerodrome, though at the time of the Garden Party the excellent performance figures of the Wellington, given elsewhere in this issue, had not been released.

VOKES, LTD.—On this stand there was an example of what happens when a Vokes filter is used in the lubrication system of an engine. Also on view were a number of Vokes filter features, including elements before and after use. The display included various types of air and oil filters, together with an air straightener.

The New Tipsy

FOR some reason or other it always appears to have been customary for civil aeroplanes, at least in this country, to be sold at a basic price which does not include all the essential equipment—this being added according to the wishes of the purchaser. Previously, the Tipsy two-seater has been offered with every item of equipment which would normally be required for training purposes at a price of £675.

From now on the standard price will be £550 and additional equipment will be installed according to the customer's orders.

THE ROYAL AERO CLUB

News and Official Notices for the Week Ended May 20

Blackpool "Lift"

BLACKPOOL, amusement centre for Lancashire and the Midlands, is the objective in a contest for a prize of £100 offered for a cross-country soaring flight from Camphill, Derbyshire. Camphill is the site of the Derbyshire and Lancashire Gliding Club, who are the organisers this year of the British Gliding Association's National Gliding Contests, to be held between July 8 and 16.

If the prize has not been won before, it will be competed for during this meeting: the total distance is about 50 miles in a north-westerly direction.

Other contests during the meeting will be the Wakefield, De Havilland and Volk prizes for the best distance, best height and best duration flights during the year, whether accomplished at the meeting or not; the Manio Challenge Cup for the best goal flight during the contests; and numerous daily prizes, to be announced by the organisers during the meeting. Last year, at Dunstable, the entries were limited to 30 sailplanes, and this number was easily reached; this year no fixed limit has been placed to the number of entries, because of the larger soaring site.

Pilota Picnic

SEVEN Hungarian guests took part in the specially organised festivities arranged by the Automobile Association and the Royal Aero Club in their honour last week on behalf of the British private aeroplane owners who had previously visited their country. They attended various functions in London, including the Royal Aeronautical Society's Garden Party on Sunday, May 14. Next day a lunch was held on behalf of the Automobile Association by Sir Stenson Cooke at the Devonshire Club, and a cocktail party given at the Royal Aero Club. The evening finished at the London Casino with the participants in the Past Magyar Pilota Picnics.

On Tuesday, 16, Mr. F. C. J. Butler entertained the visitors at Carswell Manor and the programme concluded with a dinner at the House of Commons, with Sir Lindsay Everard, M.P., the Chairman of the Royal Aero Club, as host. Among the visitors was M. Stefan Horthy, son of the Regent of Hungary.

Hail!

REMARKABLE experiments are in progress on the Monts du Maconnais, du Beaujolais and du Lyonnias with a device for protecting crops, covering an area along the basin of the Soane extending from about Lyons to Macon. The experiments are being made with anti-hail rockets fired into storm clouds. The rockets rise to about 2,000 metres and, consequently, air pilots are warned to keep clear of this area. The stations enter into action and begin their rocket firing on the appearance of a storm, and they will be working until the end of September.

Littorio Rally

THE Littorio Rally will take place at Rimini between July 16-23. Full details are now available at the Royal Aero Club. Entries close on July 1.

Brooklands' "At Home"

THE Brooklands Flying Club's "At Home" will now take place on June 17 instead of June 10 as previously arranged.

Aviators' Certificates

No.	Name	Club or School	Date
18,050	Alfred Walters	Northern Aviation Club...	7.5.39
18,051	Ralph Edward Tidswell	Northern Aviation Club..	6.5.39
18,052	Ivy Blakey...	Northern Aviation Club..	7.5.39
18,053	George Walter Gray	Thanet Aero Club	11.5.39
18,054	William Sharman Bull	Bedford Aero Club	7.5.39
18,055	Edward Roy Harcourt	Southend Flying Club	11.5.39
18,056	Ernest Jeffery Poole	Southend Flying Club	11.5.39
18,057	Thomas Bladwell Norgate	Norfolk and Norwich Ae.C.	11.5.39
18,058	Claude Thomas Cyril Foster	Plymouth and Dist. Ae. C.	6.5.39
18,059	Charles John Fooks	Wiltshire Flying Club	28.4.39
18,060	Arthur Mitchley	Wiltshire Flying Club	9.5.39
18,061	Roy O'Donnell Sizer	Hull Aero Club	8.5.39
18,062	Alfred Andrew	Hull Aero Club	8.5.39
18,063	Harold Marshall	Hull Aero Club	8.5.39
18,064	Thomas Martin Yates	North Staffs Aero Club	11.5.39
18,065	Geoffrey Barnard Merriman	Tollerton Aero Club	6.5.39
18,066	Geoffrey Raynor	Tollerton Aero Club	9.5.39
18,067	Richard Alfred Fuller	Tollerton Aero Club	9.5.39
18,068	Thomas Claud William Husband Blay.	London Air Park F.C.	10.5.39
18,069	Charles Francis Field	London Air Park F.C.	5.5.39
18,070	Nigel James Bell	Kent Flying Club	11.5.39
18,071	John Ernest Barker	Doncaster Aero Club	9.5.39
18,072	Margaret Helen Gepp	Thanet Aero Club	12.5.39
18,073	James David Donald Watt	Thanet Aero Club	12.5.39
18,074	Adolphus Burton Scott	Hampshire Aeroplane Club	11.5.39
18,075	John Windrush Newman...	Brooklands Flying Club...	6.5.39
18,076	William John Ellis	Northern Aviation Club...	9.5.39
18,077	Andrew Alexander Cameron Richmond.	Scottish Flying Club	4.5.39
18,078	Cecil Alfred Lawson	Lancashire Aero Club	6.5.39
18,079	Charles Leslie Boulding	Malling Aero Club	9.5.39
18,080	Gerald Salter	Liverpool and Dist. Ae. C.	19.4.39
18,081	Myrtle Joyce Smith	Romford Flying Club	10.5.39
18,082	Denis Lascelles Iremonger	Isle of Wight Flying Club	13.5.39
18,083	Cecil Hugh Livingstone Tulloch...	Misr Airwork, Egypt	4.5.39
18,084	Alfred Bollington	London Air Park F.C.	11.5.39
18,085	Arthur Frederick Hooper...	London Air Park F.C.	11.5.39
18,086	Paul Eyre Springman	Airwork Flying Club	10.5.39
18,087	Walter Alan Laurie	Liverpool and Dist. Ae. C.	7.5.39
18,088	Ernest Henshaw	Liverpool and Dist. Ae. C.	2.5.39
18,089	Donald James Waitt	Kent Flying Club	11.5.39
18,090	Richard Bernard Pape	Yorkshire Aeroplane Club	10.5.39
18,091	Ernest Vercoe Dunn	Plymouth and Dist. Ae. C.	7.5.39
18,092	Douglas Paul Greenwood...	Northern Aviation Club...	13.5.39
18,093	Eileen May Sargent	Northern Aviation Club...	9.5.39
18,094	Harold Sidney Davies	Northern Aviation Club...	7.5.39
18,095	Derek William Thomas	Southend Flying Club	14.5.39
18,096	David Bramwell Jephcott	Leicestershire Aero Club...	13.5.39
18,097	Harold James Mortimore...	Exeter Aero Club	8.5.39
18,098	George James Poulter	Exeter Aero Club	12.5.39
18,099	Robert Ernest Henson	Exeter Aero Club	13.5.39
18,100	Mervyn John William Skinner	Exeter Aero Club	8.5.39
18,101	Reginald Neville Walford	Redhill Flying Club	6.5.39
18,102	Arthur George Plumb	Redhill Flying Club	4.5.39
18,103	David Leach	Liverpool and Dist. Ae. C.	7.5.39
18,104	Arthur Dennis	Liverpool and Dist. Ae. C.	4.5.39
18,105	Harry Chorlton	Northern Aviation Club...	13.5.39
18,106	Cyril Simons	Northern Aviation Club...	13.5.39
18,107	Jack Foden	Northern Aviation Club...	7.5.39
18,108	John McNamara	Northern Aviation Club..	9.5.39
18,109	Stanley Eric Yates Smurthwaite...	County Flying Club	7.5.39
18,110	Eric William Cooper	County Flying Club	7.5.39
18,111	Charles Snook	Portsmouth Aero Club	12.5.39
18,112	Thomas Carton Hardman Sanderson.	Worcestershire F.C.	11.5.39
18,113	Bernard Evans	Worcestershire F.C.	10.5.39
18,114	Michael Alexander Hunter Christie	Worcestershire F.C.	10.5.39
18,115	Victor Lambert Joseph Leunis	County Flying Club	13.5.39
18,116	Ronald West	Lincolnshire Aero Club	7.5.39
18,117	Bernard James Rutty	Wiltshire Flying Club	10.5.39
18,118	Muriel Smith	Wiltshire Flying Club	10.5.39
18,119	James Allen Davidson	Newcastle-on-Tyne Ae. C.	10.5.39
18,120	William Henry Banks	No. 9 E. and R.F.T.S. Air Service Training.	10.5.39
18,121	Reginald John Knight	No. 9 E. and R.F.T.S. Air Service Training.	15.5.39
18,122	John Reginald Charles Randle	Reading Aero Club	8.5.39
18,123	Arthur Thomas Kemp	Reading Aero Club	8.5.39
18,124	Leslie Norman Thomas	Midland Aero Club	10.5.39
18,125	Philip Skelcher	Midland Aero Club	9.5.39
18,126	William Breeden	Midland Aero Club	11.5.38
18,127	John Ferguson-Davie	Midland Aero Club	5.5.39
18,128	Robert Cecil Gleadall Butler	Lincolnshire Aero Club	7.5.39
18,129	Wilfrd Laurence Tenneson	North Devon Flying Club	4.5.39
18,130	Joan Marie Doreen Instone	Doncaster Aero Club	12.5.39
18,131	Stanley Cartlidge	Doncaster Aero Club	12.5.39
18,132	Edgar Bernard Harold Hall	Yapton Aero Club	10.5.39
18,133	Peter James Booth Reynolds	London Aeroplane Club...	11.5.39
18,134	Lily Winifred Ball	London Aeroplane Club...	10.5.39
18,135	William Douglas Redmond	London Aeroplane Club...	12.5.39
18,136	Eric Beecroft Moss	London Aeroplane Club...	5.5.39
18,137	Ian Ross Buchanan	Midland Bank Flying Club	14.5.39
18,138	Henry Humphreys	Northern Aviation Club...	15.5.39
18,139	Maurice Geoffrey Harker...	Airwork Flying Club	7.5.39
18,140	Donald Whitehead Balls	Southend Flying Club	16.5.39
18,141	Matthew Mason Mallorie	Cinque Ports Flying Club	15.5.39
18,142	Evan Roger Edwards	Cardiff Aeroplane Club	15.5.39
18,143	Robert Raymond Rogers...	Cardiff Aeroplane Club	14.5.39
18,144	Cyril George Joseph Moore	Cardiff Aeroplane Club	12.5.39
18,145	George William Duckmanton	London Aeroplane Club...	15.5.39
18,146	John Wilfred Gadsby	Kent Flying Club	16.5.39
18,147	William Neville Walford	Redhill Flying Club	13.5.39
18,148	Taniya Whittall	Redhill Flying Club	13.5.39
18,149	Wilfrid Gurney Nelson	Redhill Flying Club	15.5.39
18,150	Eric Ross Robertson	Lancashire Aero Club	13.5.39
18,151	Maurice Frederick Woodhams	Malling Aero Club	16.5.39
18,152	Arthur Patston Jones	Worcestershire F.C.	6.5.39
18,153	Arthur Henry Masters	Worcestershire F.C.	11.5.39
18,154	Donald Arthur Thomas Butcher...	Cinque Ports Flying Club	14.5.39
18,155	Richard Cedric Hartley	Witney and Oxford Ae. C.	14.5.39
18,156	Elizabeth Barbara Samson	Bournemouth Flying Club	14.5.39
18,157	John Edwin Orgill	Bournemouth Flying Club	12.5.39

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